THE GENETICS OF POLITICAL ATTITUDES

By

Peter K. Hatemi

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University of Nebraska, 2007

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Political behavior just as all human behavior has biological origins. This examination explains the variation in political behavior as being partly heritable potentially derived from evolutionary natural selection pressures, partly familial socialization and finally, partly unique experience. I present empirical evidence that the traditional environmental theories of political behavior, rational choice and behavioralism, do not adequately explain all the variance in human political behavior; neither theory attempts to take into account where preferences come from, rather they focus entirely on an individual's reaction to their environment. Analyzing twin data from the perspective of biometrical genetic theory combined with the methods of behavior genetics, this study examines the additive genetic, common environment and unique environmental sources of political attitudes, party identification and vote choice.

ACKNOWLEDGMENTS

Part of my research required me to read a good number of dissertations. I always read the acknowledgments as it gave me a certain insight into the author. I have noticed two main types of acknowledgments; the very curt and to the point minimal thanking of those who directly contributed to the piece, and the grand thanking of everyone from their grandparents giving birth to their parents and even thanks to the town butcher. I have followed the latter. If you are a personal acquaintance of mine, read on, you may find a small piece in there for you. If you're not, let me save you the pain- just skip on down to the table of contents as my personal sentiments will likely bore you.

The road I have taken in life, which has currently culminated with the completion of this dissertation was not a well traveled one, and the best and worst moments of my journey have been shared with many people. I have been truly privileged on this journey as the friends I have made will forever remain dear to me. I cannot separate the dissertation from my personal life. I am in this field by choice, and my work is nothing if not personal. It is difficult to know where to start or to end in recognizing those who have been a part of my personal and academic success, and in doing so I have no particular order, but I can think of no better place to start than with my big brother.

For Jon, my only family member by relation, I cannot find the right words to express my deepest respect, love and gratitude. Six years ago, Jon seeing me in my former profession, commented on my state of life and general disposition. I recall the conversation, "Maybe you should go back to school and be a professor; isn't that what you always wanted to do once you started college?" Six months later I started graduate school at the University of Nebraska. Today, almost 5 years to the day, I have earned my doctorate. Thank you Jon, for all the times you have been there, for your friendship, your character, your guidance and your support. I am proud to have you as my brother.

For those that know me, they know my time in the service was the most important in my life. I was born twice, once at birth and once again in the Army. Thank you to all those that served with me. The best of us sacrifice so the remainder don't have too. The bonds of brotherhood, and the trials we endured guided me to become the man I am today; which has almost everything to do with all of you. For those no longer with us, the remainder carries on. Joseph and Chris, wherever you are, I would not be here if you weren't there-*De Oppresso Liber!* And to Russ, fight on! We are all still waiting for you. Skip and Mitch, my brothers, though more than 17 years have passed since this journey began, we're all still teenagers when we get together. I have always needed those moments more than I can explain. Inseparable in this life and the next, it's hard to find the words, but brother is the closest I can come. There is too much to say to say it, but thank you. And to Top, thanks for making me do 50 push-ups for every word in the *New York Times* I could not pronounce, spell or define. This man made me hungry for knowledge and understanding, and instilled in me a desire to give back to others the help he so generously gave me. So how about you do 50 push-ups for every word you cannot pronounce, spell or define in this dissertation?

It seems like yesterday when I met John at CSUN, and only a few months ago I was standing next to him at his wedding. While I can't say thanks for the worst case of food poisoning one could have due to the rehearsal dinner, I will always remember when John looked at me and my 1969 FJ40 Land Cruiser when I said I was driving cross country to finish my bachelor's at WVU. "Not alone you're not." Since then I'm certain John regretted that choice as he threatened to burn my cruiser to the ground if I brought it back to LA, but I think I would not have changed a moment of our adventure. From the radiator blowing 20 miles out of town, to the lights shutting off, to the electrical catching on fire in the Utah desert, to the engine not starting in Colorado, then not turning off in Kentucky…John's always been there when it mattered. Thanks John.

Scott and Audra – whether for a good meal, or place to rest my head, or for football, or for holidays, you and your family have been a family to me, especially during my lean years of being a grad student, you've always been there. Thank you and all the Call girls so much!

How could I leave out the Feemdog; whether in Southern California, Mexico, Nebraska, or Australia, he always seems to turn up at the right time. While I can't say Feemster ever contributed to anything academically, he sure have made my life more enjoyable. Whether I needed a couch to crash on, someone to carry my ruck, or a fellow sushi eater, thanks my brother!

College was a foreign thing to me in my youth, something I could only watch on TV. I was more nervous to go to college than I was to deploy. Everything seemed to be beyond my understanding. Two professors in my undergraduate guided me on a different way of thinking, Jim Fairbank and William Spangler. Thanks gentlemen, your guidance and friendship made a difference.

"Friends are the family you choose…" Edna Buchanan could not have been closer to the truth. I'd like to thank my family, and I can't choose the order, I wouldn't know how. To my ambassadors of fun, Andrew, Eric, Hani, and Joe: Andrew, thanks for always providing the good stuff, a cold drink, good food, and a warm place to stay, and for always taking care of the details, whether Big Sur or Montreal. Eric, if I had an older brother that was younger, you'd be him. The conversations, Montreal, the laughs, the incredible meal your mom made, and actually reading the first article I ever published…where do I end and begin? Thanks Eric. Hani, anytime you need a lemon squeezer just call. How you cooked for 100 people and still managed to have fun, I'll never know. Thanks for Memorial Day and New Years and the most comical airplane experience of my life. How is it you and I always end up shopping for food anyway? The more we hang out the more certain I am I went to SD and not WV for college. Joe, thanks for the music, and the laughs hiking on the mushroom trail, for letting me DJ at new years (major mistake). Hey, what good is a DJ without music? Countless hours of dissertating I spent rolling away to your tunes. Spin away Joe, spin away! And at last, Tesh, who's friendship has changed my life in so many ways. Thanks for always coming through, delivering the impossible, being you and being a true friend. My life has become infinitely richer since you entered it. Thanks for always making me look better than I actually was, and for your indomitable spirit. You have my utmost respect and admiration. Most of all thank you for bringing me into your family. Through you Tesh, I have built friendships that became my family. My transition from the Army was difficult, and until we met I thought I would never make the same kind of friends again.

All of you have been there every step of my journey, through leaving the Army, to the professional world to entering academia, through the master's to the PhD.

Mike my spiritual advisor, and personal reverend (I wonder if I am still the only member of his congregation?), thanks for being you and being there for me. Tom, thank you for opening your home and heart to me, thank you for cooking good food, supporting me in times of trouble, and understanding when I am a pain in the ass. Thanks for rehabbing with me through my knee surgery, always having a jacket I needed to borrow, and being a great friend. And thanks for reading and helping edit my master's thesis!

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How could I forget Shannon and her apartment? After celebrating a success in SD, I had an epiphany, woke up and wrote the entire second chapter of my dissertation in her dining room. It's quite possible her dining room table has evolutionary thoughts. Don't ever sell it, I may need it again for my next book! Ryan and Ari, don't ever change. Every time I see you, and your smile you make me smile. Erica, my ego booster; helped in ways I doubt she realized. Her emails always make me laugh, and I can't remember which one specifically, but I was having a bad brain day and she sent me an email out of the blue that made me feel smart again! It's always the small things that matter, and good friends just seem to always do the right small things. Kathy Mac, if I had a big sister or could choose one, you would be her. How is it you lived in Japan and now Thailand, and I still have yet to come see you? I've lived in your place during my master's years at

times, and I'll always remember your mentorship and confidence during my professional career. Thanks Kmac.

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The informal members of my dissertation committee were truly remarkable. Lindon and Nick brought a much-needed scientific perspective to my work, analytical skills, and a common sense view that improved the final product. Nick Martin is simply unique, and there is no way to enumerate the assistance and support he has given me in such a short time. In the few months I spent in Brisbane, Nick was always willing to answer questions, and develop my writing ability and even co-authored my first publication. Nick remains a strong source of support throughout the course of my research. I had meals in his home, full access to his lab, post-docs and PhD's, and of course coveted data. I learned so much from him in matter of months. Let me simply say that Nick has been an inspiration to me - he is consistently two notches above excellent in his devotion to research and the development of students, whether or not they are his own. Nick, thank you for developing my abilities, funding my time in Brisbane among other things, and treating me as your own student. It is a joy to know you.

Nick's advisor, Lindon Eaves has now become my own. The father of modern BG in many ways it seems, it's a privilege to work with him today and I look forward to our future endeavors. Thank you for your guidance, thoughts, your career's devotion, your interest in developing my abilities and your generous support and access to your life's work. Through my dissertation I began several projects with Lindon and just being part of this process has changed the way I think about the study of political phenotypes. For certain my career path is forever changed. Thank you for the privilege of working with you and for taking me on as post-doc. I think we're going to cause quite a ripple in the study of social and political behavior; even more important, just the few hours in your home made an impact on me personally and not only are we going to be productive but it is going to be a lot of fun.

If there is one clear element that made this work possible, it is the generosity of Nick and Lindon. The decades of personal investment in developing the twin registries, collecting the data, developing the methods and training those who continue to build from their efforts is what made this dissertation possible. All of the data analyzed here have been collected, examined and often published on by Lindon and Nick. This dissertation is simply the latest effort of what they started in the 1970's and everything original in this work is due to their original work. A simple thank you feels wholly inadequate.

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Contents

Chapter 1 – Lines of Inquiry

> "Genes start our lives; they give us a beginning. But neither they, nor we, are totally predetermined" (Blum 1997: 21).

Why do people do what they do? In the scholarly disciplines that examine human behavior, it is the question we all attempt to answer in some form or another. Examining political behavior is no different; it as much an area of biology as it is political science. Political science tends to focus on political context, political attitudes and political behaviors in general, and disregards the biological organism that expresses the behaviors we examine. In effect, we examine the behavior of our species without taking into account our species.

As such, there remains a single "environmental" dimension used in the discipline of political science to answer where our preferences come from and why we do what we do. The overwhelming majority of political research posits that preferences are based on socialization or personal experience (environmental) factors or "given", which often leads to reductionist, stimulus-response behaviorist frameworks, placing 100 percent of behavior differences in the environment.[1] However, the vote choice for president or party support, or even policy preference is only the end result and outcomes only show the expressed attitude, they do not explain the origin of the preference or the process for how this preference is developed, interpreted and expressed.

The traditional approach to examine the difference in political preferences is a result of the separation of the research programs that the biological and social sciences use to examine behavior (Masters 1990). Unfortunately the biological and social sciences not only developed separate research methods, but they largely remain independent of one another, which limits a more complete understanding of political behavior (Somit 1976). While political scientists ask the interesting questions and provide thorough examinations of environmental influences, biology and evolution provide the

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[1] Some scholars such as Corning (1971) go so far as to imply environmentally driven theories make us little more than Skinner's rats.

theoretical basis for the development of human origins and subsequent political institutions and the hard sciences, such as physiology, neuroscience, neurophysiology, genetics, and neuropsychology can provide empirical data on human nature and physiological decision processes (Corning 1971; Masters 1990).

Heritable individual differences present the basic material for the study of human development and evolution; nearly all features of human anatomy, physiology, behavior, and cognition show that variability is partly heritable (Eaves 1977; Geary 1998; Martin 2006). Unfortunately only a handful of political scholars (Nelson 1974; Alford et al. 2005) attempt to empirically integrate biological theories of behavior and the traditional social science theories of behavior. Empirical research in the social sciences has largely ignored the importance of biology in explaining behavior.

The dual research agendas of biology and social science will undoubtedly contribute to yet another incarnation of the ongoing philosophical tension in political science, this time between environmental and biological perspectives on individual variation akin to the behaviorism/behavioralism/rational choice debates. However, this new wave of debate is somewhat different than the rational choice or behavioralist critique of behaviorism; the source of variation in both of the aforementioned competing theories continues to be ultimately derived from the environment, however biology is entirely different.

Indeed, ontological premises about biology and evolution have grown more profound in recent years as biology incorporates more than that which we can only observe from survey evidence, or experiments based upon visual observation. However I am not attempting to draw an intellectual line in the sand, or juxtapose biological and environmental approaches as polar opposites. Rather, environment is a central component of biology and heritability. It is reactions to the environment that ultimately drive variation and this variation is passed on through offspring and population shifts. Therefore, the conceptual rift between those supporting biology and evolution as a source of political attitudes and those who oppose it can be a vehicle for scholarly progress by combing the findings of both. In this endeavor I consider premises about human's genetic makeup and heritability being interactive elements with the environment to account for the variation of human's political attitudes. The intellectual possibilities, the elements of human political behavior that we can examine using genetic and evolutionary approaches are as diverse as the human phenotype.

The Dissertation Thesis

This study is an attempt to explain human behavior as the interaction of "emergent endogenous and shifting exogenous forces" (Losco 1985), by examining what part additive genetic (genes), common environment (familial socialization) and unique environmental factors (personal experience) play in political expression using biology as the explanatory theory as to why certain political attitudes and behaviors are heritable. In short, behavior is dependent on the interaction of biological and environmental factors and is not reducible to either source alone, and this interaction has shaped the development of our species.

I will not attempt to show that people have different issue positions solely because of their genes, neither will I attempt to show which genes may be largely responsible for specific political behaviors. While the latter is a worthwhile endeavor, it requires years of data collection and genotyping.[2] Nor will I attempt to provide evidence of evolution and human behavior; this has already been done. Rather this examination follows initial works in the behavior genetics discipline focusing on twin studies (Eaves 1977; Martin et al., 1986; Eaves et al. 1998; Eaves et al. 1999). I posit that political attitudes and behaviors have additive genetic potential, evolved and passed on from our ancestors, and that the importance, strength, and variability of these components, as well as the direction of the issue positions, are in part due to our genetic makeup.

Using twin data it is possible to explain the source of variance in certain attitudes and with genotyping potentially where they originated. Thus making it possible to being able to make individual level conclusions on which position someone will take.[3]

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[2] A genotyping study is currently underway in collaboration with Nick Martin, John Hibbing, John Alford and the Queensland Institute of Medical Research.

[3] While these types of studies are conducted for medical and psychological traits they have not yet been performed for political behaviors.

Questions such as “Why are some people more political than others?” or “Why do men have stronger feelings on pornography than women?” or even why men approve of pornography more than women may be possible to answer with more than survey questions. The socialization factors are well addressed in the literature, as examining environmental factors are the mainstay of political science and have produced and continue to produce important findings. However, existing political science examinations of behavior today often explain little of the overall variance in behaviors. It is common to find R-squares as low as .06 and rare to find them higher than .5 (Matsusaka and Palda 1999). In short, while political scientists find significance in their models, they are unable to explain much of the variance in behavior. Furthermore, almost none of the existing literature asks what part of the variation in political behaviors is due to our genes? Or if genetics add to the explanatory capacity of our current models?

The nature-nurture debate is not in question.[4] It is widely accepted in science that human behavior is not pre-determined, nor is it uninfluenced by our biology; it is a combination of both environment and biology (Somit and Peterson 1988; Quammen 2004; Martin 2006). Yet little attention in the scholarly discourse of political attitudes in the social sciences has been given to the examination of the biological foundations of political attitudes. Of those, only one is empirical in nature (Alford et al. 2005). Furthermore, while a majority of the political behavior literature is based on the belief that all behavior is due to environmental conditions, by design studies in the social sciences do not empirically determine the source of the environment, whether familial socialization (common environment) or unique individual experience (unique environment). Rather, the type of environment is assumed by the variables chosen in any given study. Typical studies consider items such as “religion” as a socialization variable and “being victim of a crime” as a personal experience variable without empirically testing if this classification is correct. However, potentially every variable has both unique and common sources of variance. Thus the current studies in political science continue to use the highly imprecise method of “common knowledge” when

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[4] Most scientists agree that the pure “nurture” followers lost this debate in the 1970’s (Martin 2006).

environmentally partitioning variables into common (socialization) or unique (personal) categories.

Therefore, the specific questions this research undertakes are: can preferences in political behavior be partly explained by genetic make-up? Are political attitudes truly heritable (was Alford et al. (2005) correct)? And the most newsworthy question: are our most fundamental political behaviors such as vote choice and party identification also heritable? What part of the environmental variation in political behaviors is due to family and socialization, and what part to unique experience? And is there a different source of variation for men and women other than socialization?

Answering these questions will incorporate the methodological approaches and findings of the scientific disciplines into the realm of political science, and in order to pursue this research agenda this investigation deviates from the accepted theoretical norm. It is no secret that the study of political behavior has become increasingly limited to models of rational choice, self-interested benefit-seeking utility-maximization.[5] These models of thought or research paradigms are at the core of what we know to be acceptable explanatory frameworks in political science as American political scientists often explain all behavior in terms of socialization and environment (Somit and Peterson 1998; Alford et al. 2005). However, rational choice and behavioralism do not address how biological factors account for part of the variance in human behavior. Both theories take preferences as given; they do not address where preferences come from (Landemore 2004). This "black box" approach is precisely why our traditional explanatory theories are incomplete and cannot account for inherent differences.

However, if our preferences have a genetic component, the natural question for political scientists would be, "how do we get inside the body and the brain to identify preference structures?" And "how can we examine the evolution of behaviors?" Modern biometrical theory and the behavior genetics fields have provided a means so that we do not need to. John Alford, Carolyn Funk and John Hibbing (2005) used existing twin

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[5] Behaviorist, behavioralist, cultural and structural explanations are still employed, however political science has become increasingly dominated by rational choice.

research to show that political attitudes are in part heritable; posing a significant challenge to the belief that rational choice can explain all behavior. It is the only empirical political science examination known to this author of biological models of behavior.[6] However as any good journal article, it is limited in scope and breadth, and in their examination they only analyzed attitudes; they did not examine behaviors, particularly the most fundamental political behavior, vote choice. Nor did they address differences in heritability between males and females. In addition, they utilized a limited method of analysis proposed by Galton and used up until the 1970's (Falconer 1960) but largely abandoned in current twin research due to the introduction of recent SEM variants based upon Jinks and Fulker's (1970) ANOVA methods. Finally the initial examination did not test reduced models to eliminate the additive genetic or common environmental components. In effect Alford et al. (2005) assumed every trait examined has all three sources of variance (common environment, unique environment and genetic) without explicitly fitting the data to reduced models removing one or more of these components.

Background and Significance of the Study

My goal is to provide a thorough explanation of the sources of variance in political behavior and attitudes, and to provide a framework for the future study of the genetic, common environment and unique environmental components of political behavior and attitudes. Although there have been sporadic works in political science examining innate determinants of behavior and several movements in the biopolitics fields, there are few empirical examinations.[7] E.O. Wilson (2002) stated "The boundary between the natural sciences on one side and humanities and humanistic social sciences on the other is not an epistemological fault line, but a broad domain of poorly understood material phenomena that invites cooperative exploration from both sides." This study is an empirical attempt to overcome just that. Specifically this study adds to the existing

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[6] Lindon Eaves and Nick Martin initially produced similar results as early as the 1970's in the field of behavior genetics. Alford Funk and Hibbing utilized and re-analyzed their data presenting it the political science community.

[7] The term "biopolitics" has two meanings in the literature; the political study of biological issues (cloning etc) and the biology of politics (heritability, evolution, genes, etc contributing to human behavior) (Somit and Watts 1994). For this study, I use the term biopolitics as the latter.

literature in the following ways: (1) provides a methodological framework for the heritability of political attitudes; (2) examines the heritability of vote choice, party identification, and strength of party identification; (3) provides additive genetic, common environment and unique environment estimates on prominent political items and behaviors including vote choice and party identification, as well as test reduced models to rule out additive genetic and common environment components; (4) updates the Alford et al. (2005) findings utilizing the most recent structural equation modeling techniques, including opposite sex pairs and equal environments testing; and (5) Examines the differences in sources of variation for political attitudes for males and females.

Organization of the Study

The arguments I drafted above are predicated on the belief that human behavior originates from evolved natural selection pressures and that not all behavior can be attributed to rational cognition as a reaction to environmental stimuli, nor are all preferences based upon familial upbringing. As such, Chapter 2 introduces biology and evolution as a larger framework that incorporates the human mechanisms for political attitudes prior to a "rational choice." However, nothing is more rational than evolution; it just operates at a different level of analysis. This chapter is central to explaining the thesis. I will draw upon biology, genetics, evolutionary psychology, and the earliest proponents of evolution to build a framework for political analysis. I will provide an examination of the literature, and findings utilized in biological and behavior genetics research. This chapter will also include a discussion on why rational choice and behavioralism cannot account for all behavior or attitudes; particularly given that certain attitudes are heritable and not based entirely upon expressed and overt cognitive decisions or reactions to external stimuli.

Chapter 3 focuses on the use of twin studies and their importance to this research and provides a comprehensive methodological review for future classical twin examinations of additive genetic, common environment and unique environmental sources of variance in political behavior. This "methods" chapter will introduce the use of twin design structural equation modeling (SEM) to examine political constructs. The majority of behavior genetics research utilizes SEM and as such this chapter will incorporate the most recent SEM methods and explain how to apply them to the analysis of political attitudes and behaviors. I will include an overview of the twin method, an explanation on decomposing variance, assumptions, estimating variance, sub-models, model testing, the importance of sample size and power analyses.

Chapter 4 provides empirical evidence validating the Alford et al. (2005) study that political behaviors are in part heritable. The initial examination will update the findings in Alford et al. (2005) using the same "Virginia 30K Twins Registry" data set that utilizes a political item subset of the Wilson Patterson inventory along with other behavioral items –educational attainment, religiosity, religion, and partisanship. I also incorporate the "Australian Twins Registry" data set for cross cultural examinations. The first hypothesis tested in Chapter 4 provides evidence confirming political attitudes are in fact heritable. The initial study (Alford et al. 2005) did not test reduced models to verify that only common environment or unique environmental sources of variation were a better fit than models including an additive genetic source of variation; they also did not test to see if only additive genetic and unique environmental sources were a better fit than models including socialization (common environment). In addition, since only one piece of research exists in our discipline examining heritability, it is appropriate to replicate and validate these findings using the most robust methods and additional evidence (an Australian study) to provide converging evidence.[8]

This chapter will also provide a test of the main critique of the twin method, the equal environment assumption (EEA); though the critiques have been repeatedly found to be without merit in most examinations of behavior and personality, the potential violation of the EEA has not been tested in the literature for political attitudes.

Chapter 5 examines the genetics of voting and party identification. The central hypothesis is that if issue attitudes are a proxy for voting behavior and strength of attitudes are heritable and political attitudes are heritable in general, then so should our most specific political behaviors; therefore I hypothesize that vote choice is also

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[8] The Alford Funk and Hibbing piece used polychoric correlation analysis and did not test reduced models.

heritable. However, the directions of one's party affiliation are another matter. Based on the existing literature whereas religiosity is heritable, but the identification with a specific religious denomination is not, I posit that party identification is not heritable, but strength in party identification, similar to strength of religiosity is. The examination of vote choice and voter affiliation has and continues to be at the forefront of political science research, and this study will be among the first to examine their genetic components.

Chapter 6 examines the difference in the source of variation for political attitudes between males and females. Traditional gender gap literature focuses on the greater support women give to liberal issue positions and the Democratic Party (Shapiro and Mahajan 1986), and explains this difference by the different socialization of males and females (Chodorow 1978); females mainly having an ethic of care and males an ethic of justice (Gilligan 1982). These premises are examined and compared to evolutionary hypothesis which base inherent differences in social behavior by the different specialization requirements developed for males and females due to their different selection pressures (Somit 1976). Heritability estimates are produced for men and women and tested for significant differences.

This dissertation will conclude by addressing the importance of both environmental and genetic examinations of behavior, by explaining how to use twin studies to examine environmental sources of variation, and by providing a foundation for future paths to be taken.

Chapter 2 –Biology and Evolution as a Theory for Political Science

This chapter presents biology and the theory of evolution as the potential foundations for political behavior, and behavior genetics as a means to empirically test evolutionary and biological hypotheses. As such I begin with an explanation of why political science's dominant paradigm, rational choice, cannot do the same.[9]

Traditional rational choice or behavioralist arguments rest principally on external stimuli as the ultimate cause for all human behaviors and attitudes, political behaviors being no exception. Rational choice assumes preferences as given and is unconcerned about their source, whereas behavioralism assumes that all behavior is the result of attitudes derived from social conditioning (Lichbach 2003; Alford and Hibbing 2004). Both discount that human behavior starts from somewhere and neither theory addresses the human organism, physiological needs or drives. Both theories ignore humanity's past existence and biological development, why humans developed in the fashion we did, as individuals and a society. As such, both rational choice and behavioralism, while adept at explaining environmental aspects of behavior only include part of the story and neither offers a complete theory for human behavior.

Is "Rational Choice" Rational?

> "There is no longer any doubt…the expected-utility model of economic and political decision making is not sustainable empirically…" (Jones 1999).

At the same time that rational choice is increasingly asserted as the dominant research paradigm in political science, the dominance of rational choice as an explanatory framework for all human behavior has increasingly been questioned outside of political science (Cosmides and Tooby 1994; Cosmides and Tooby 1997; Robson and Kaplan 2003). Numerous challenges from scholars of economics, psychology, neuroscience and

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[9] As rational choice has replaced behavioralism as the dominant theory for political attitudes, I concentrate my critique on rational choice; however rational choice and behavioralism share the same shortcomings in their dependence on the environment. For a detailed explanation of the shortcomings of both rational choice and behavioralism see Alford and Hibbing (2004).

other fields have found that rational choice only applies to choices motivated by self-interest and rational choice is only interested in choices as "revealed preferences" or end results; as such recent scholarship has produced and replicated evidence that rational choice has increasingly been found unable to explain all behavior (Dawes and Thaler 1988; Tversky and Thaler 1990; Fehr and Gachter 2000; Gintis 2000; Henrich et al. 2001; Fehr and Fishbacher 2004).[10] Rational choice ignores the decision making process and cannot account for certain behaviors, such as acts of pure altruism or suicide and it ultimately leads to a tautological method in its "thin" form as any action, even an irrational one, can be explained by hidden "preferences" (Landemore 2004). Furthermore, not only are preferences absent in many circumstances, but they are relative and volatile and based upon non observable internal processes.[11] As rational choice ties all outcomes to preferences, it misses the preceding logical steps; where do preferences come from?

Brosnan and de Waal (2004) provide a very simple example of the fallibility of absolute gains and rationality by conducting an experiment teaching monkeys to receive tokens as a reward and then barter them for food. The monkeys learned to be content to swap tokens for cucumber, but if the researchers gave one of the monkeys a grape, a better tasting food, the other monkeys would act irrationally and refuse to hand over their tokens for cucumber; in some instances they would exchange their tokens for cucumber, but refuse to eat it. The monkeys clearly pay attention to what other monkeys are doing and act differently when other monkeys receive a better reward; thus relative gains are more important to monkeys than absolute gains, defying the tenets of rational choice.

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[10] Dawes and Thaler (1988) find that not everyone free rides when they can, thus not all actors are rational. Several other anomalies persist in payoff games; whether endowment or preference reversals, experimental evidence concludes that people behave other than rational choice would have predicted. Tversky and Thaler (1990) find that people do not have fixed or pre-defined preferences about every situation. Instead preferences are modified and developed during the process of making a decision; thus challenging rational choice on yet another level, as it is not the outcomes that determine preferences, but the internal decision process, an area that rational choice completely discounts as exogenous.

[11] Some remain unimpressed by the "anomalies" evidence. Jones (1999) argues experiments do not accurately portray the real world. Regardless, even if the experiment scenarios are artificial, the decision processes are real.

Although monkeys are not running for office and do not make up our electorate[12], similar experiments with humans show that people become less cooperative if treated unfairly, and punish uncooperative people even as their own reward declines as a result, even when they have no tie to the person being treated unfairly, and when there is no expectation that they will recover the cost of punishing. This remains true even when the "altruistic punisher" does not get to observe the punishment being handed out (Fehr and Gachter 2000; Gintis 2000; Henrich et al. 2001; Fehr and Fishbacher 2004; Alford and Hibbing 2006a). This reaction in both humans and monkeys points to some internal primate process that may shape motivation and preferences. Even "thin" rational choice would be pressed to advocate that being angry was preferred to eating, or that people prefer to have less, thus explaining why the monkeys refused to eat cucumber, and people altruistically punish.[13]

In the face of verifiable and empirical evidence that all behavior is not explained by self-interested utility maximization, supporters of rational choice dismiss these concerns claiming these observations are "anomalies" and protest that rational choice is the most scientific theory for social science. William Riker (1990) states that the disparity in development between the hard and social sciences is due to the fact that social science research is not based solely on rational choice. Yet those in the hard sciences strongly disagree, and find that rationality as defined by Riker and others frequently has little to do with behavior (Fisher 1918; Eaves et al. 1989; Martin 2006). Cosmides and Tooby (1994) argue that the main tenet of rational choice, rational behavior being a state of nature, is decidedly untrue:

> "The Brain is a complex computational device…that takes sensory information as input, transforms it …stores it, analyzes it, applies decision rules to it, and then translates the output of those rules into muscular contractions we call behavior. We….have no more access to the structure of those programs and the decision rules they embody than to the process through which the kidneys select what to excrete."

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[12] This may be debatable and I am open to research from those who would argue otherwise.

[13] Rational choice is even questioned on the foundation that rational action is self interested. Gintis (2000) emphasizes the misnomer that rational action is self serving; "In neither the everyday nor the narrower economic sense of the term does rationality imply self-interest."

This is an amusing contradiction to Riker and others. The foundation of rational choice is dependent upon the assumption we act rationally. However research in neurophysiology, neuropsychology, neuroeconomics, behavior genetics and other "science" disciplines does not find that we are rational, control our rationality, or have the knowledge to do so (Bruel 1970; Dawkins 1976; Alexander 1987; Cosmides and Tooby 1997, Bjorklund et al. 2001; Gintis et al. 2003; Kendler et al. 2005).[14]

Although proponents of rational choice in the realm of political science claim hegemony in methodology based on the foundation that rational choice is utilized successfully by economics and the hard sciences, they neglected to address the lack of a consensus on the dominance of rational choice as an explanatory factor in human behavior among those scholars in the hard sciences, or the movement away from rational choice by the discipline (economics) that introduced it (Hogarth and Reder 1987).[15]

Authors in the prestigious *Journal of Economic Literature* have even gone so far as to claim rational choice's predictive models as "a con game of a very odd sort" and engage in "endless thinking about imaginary economies that don't ever have anything to do with the world" (McCloskey 1983).[16] More convincing, is the recent capture of the

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[14] There is one theory of rational choice worthy of mention that includes internal mechanisms (bounded rationality); however this theory is not empirically tested outside of simulations. The main tenet of bounded rationality, as outlined by Jones (2001 and 2003) and initially Simon (1959, 1979 and 1985), are that humans are intentionally rational, but due to cognitive limitations are prevented from acting in a truly rational manner all of the time. While initially bounded rationality appears to "explain" behavior in manner that departs from the classic narrow rational action/motivation design, once followed through to its end bounded rationality explains the same amount of human behavior as rational choice; it brings scholars no closer to providing a model of human behavior that allows for empirically testable hypothesis or predictive analyses. Jones (1999) broader conception of rational choice that permits rational agents to incorporate emotional and cognitive factors appears sound, however simply stating that preferences are inherently bound by individual mechanisms that cannot be externally measured in effect is as tautological as "thin" rational choice. The concept that rationality is bounded by human cognition and emotional constraints is novel, but bounded rational theorists offers no empirical source for the bounds, no universal or individual explanation for why each person has certain limitations or constraints and thus empirically is not falsifiable.

[15] Amos Tversky and Daniel Kahneman began the movement in earnest in their 1974 *Science* article; a decade later at the University of Chicago (1986) a wide array of social scientists presented behavioral economics papers. By 1997 the Quarterly Journal of Economics devoted a special issue to behavioral economics and several years later the Nobel Prize was awarded for behavioral economic research.

[16] The *Journal of Economic Literature* maintained the highest impact factor in economics from 1985-2005 (see http://www.sciencegateway.org/rank/index.html).

Nobel Prize (2002) by behavioral economists (the study of how people do not make rational choices), Daniel Kahneman and Verron Smith.

One of the strongest sources of evidence that people do not act solely on the basis of rational cognition as defined by political scientists is provided by experiments utilizing functional magnetic resonance imaging (FMRI) technology. McCabe et al. (2001) viewed the brain activity of subjects who play an ultimatum game against humans vs. those who play against computers.[17] When viewing the FMRI results, subjects playing against a computer only show brain activity in the parietal cortex, the computational or rational part of the brain, but when the subjects play against humans the entire brain is active, including the emotional regions. The subjects use more than rational calculation when playing against other people; this is important because we live in a world of people! Similar experiments by Sanfey et al. (2003) find that negative responses in the ultimatum game are related to activity in the anterior insula (emotional center), while the dorso lateral prefrontal cortex activity (cognitive center) remains constant; when the emotion center was highly active the subjects responses significantly differed from those with just prefrontal cortex activity. In essence, rational behavior can be limited by physiological and emotional constraints. Thus, although humans can make cognitive choices and benefit maximize, we also use our physiology and emotion in our decision making dynamics.

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[17] A typical ultimatum game is set up with a proposer and a responder. The proposer is given a certain sum of money and asked to split the money with the responder. If the responder accepts the offer, the money is divided as proposed. If the responder rejects, both players receive nothing. If this game is played by rational players who care only about their own monetary payoffs, then in equilibrium the proposer offers a very small share such as 1$ out of $20, and the responder accepts. In repeated experiments, proposers' typically offer a share closer to one half, and this is accepted. When proposers attempt to allocate a significantly larger share to themselves, responders usually reject the proposal; thus in effect giving up any monetary gain in order to "punish" a greedy proposer. Results have been similar across countries and economic regions and with large sums of money (Roth et al. 1991). However, there is one case that produced very different results. Henrich et al (2001) conducted an ultimatum experiment on the Machiguenga, a hunter-gatherer group who live in small extended family units in the Amazon, and found that the mean share offered by the Machiguenga was only 15 percent, making them the only truly "rational" people observed. So there are rational exceptions to the rule of irrationality. Regardless of how small a share, the Machiguenga accepted offers about 95 percent of the time. Importantly, for the Machiguenga, "cooperation above the family level is almost unknown."

A most intriguing experiment conducted by Glimcher and Rustichini (2004) illustrates this concept by isolating a single neuron and determining its relevance in decision making. They trained a monkey to recognize that by looking left when prompted to make a looking decision the monkey would receive a juice reward 40 percent of the time, but by looking right would receive the juice 60 percent of the time. Examining the brain activity during this decision process revealed that after the learning period the monkey exhibited no activity in any part of the brain outside of the single neuron in the eye when faced with the decision task. In other words, the monkey's optical neuron encoded a defined expected utility and in turn reacted in anticipation of a preferred outcome without ever accessing the brain.

While most evidence finds that primates, including humans, often do not always act in a utility maximizing way, as emotional constraints prohibit or supersede decision making capability, Glimcher and Rustichini (2004) provide evidence that in certain situations the single neuron is rational (unbeknownst to the individual), even if the brain and person in their entirety is not. So while rationality exists, it is not the rational choice that scholars in the social sciences use nor is it a choice humans may be aware of, rather it is rationality prior to and after environmental stimuli. It is rationality at the biological level. The source of our preferences are in fact biological at times.

Starting the Story Half Way Through

If traditional environmental theories such as rational choice and behavioralism are incomplete, the question then becomes what theory do we use to explain political behavior and attitudes? Ironically, the answer may be in taking Riker's (1990) advice and employing research methods and theory from the natural and physical sciences. A re-emerging wave of thought utilizing biology, evolution, physiology, emotion, genetics, and heritability has been introduced as explanatory factors of political behavior (Corning 1971; Nelson 1974; Losco 1985; Martin et al. 1986; Eaves et al. 1989; Sober and Wilson 1998; Eaves et al. 1998; Truett et al. 1999; Marcus 2002; Dolan 2002; Ridley 2003; Hibbing and Alford 2004). The most recent empirical studies are based upon the pioneers in the behavior genetics (Eaves et al. 1984; Martin et al. 1986).

Evolutionary theorists assert preferences are inherent; political behavior is influenced by heritable genetic traits which are the product of our species evolutionary past (Watts 1983). Our preferences come from our interaction with the environment over-time and passed on to our offspring who utilize these inherent abilities in our day to day actions on an almost unconscious level (Tooby and Cosmides 1990). As our evolutionary past has made us highly adaptable, humans are able to integrate the social context of the day with evolved traits of the past. Human's adaptability is an evolved trait. Thus behavior is a function of genes X current environment passed on through multiple generations. While our behavior is not predetermined, it is influenced by heritable traits that develop with interactions with the environment compounded over generations.

The evolutionary theorists accept the importance of the environment as human adaptations that are passed-on are only done so as reactions to the environment. Thus, in the face of similar genetic traits, humans often have different preferences and behaviors (Tooby and Cosmides 1990).[18] In other words, the environment is given at least if not more consideration in evolutionary theories of behavior than that described in rational choice and behavioralism; evolution considers both the past and present environment. The environment affects human's internal preferences and external expression of those preferences, developed over time as a species. Rational choice and behavioralism only include our current environment and either discount all inherent properties, or assume them as given without any explanation for variation.

However, evolutionary theories find that the typical social science research designs are also necessary in explaining the current environmental impact on behavior. Neither the genetic component nor the environmental component alone can account for more than a portion of behavioral variability (Corning 1971; Eaves et al. 1989; Campbell 2002; Eaves et al. 1989). As such, although rational choice in its current form(s) appears to reject evolution, physiology and heritability as a source of attitudes, evolution does not reject rational choice, behavioralist, or other frameworks used to explain environmental

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[18] Genetically identical individuals also exhibit differences in behavior due to physiological environmental differences (in utero differences etc).

influences. Evolution is rational. This is vital to understanding the importance of heritability; proponents of evolutionary theories do not advocate the dismissal of rational choice or behavioralism, only that the environment is part of the equation instead of the whole equation.[19] By utilizing the theory of evolution and incorporating inherited traits to examine political attitudes, political scientists can introduce a theory and methodology that has driven and continues to produce some of the most important scientific findings of our lifetimes and bridge the gap between the social and hard sciences (Wilson 1987; Economist 1997; Kurzban et al. 2001; Kurzban and Leary 2001; Ridley 2003; Quammen 2004; Wilson 2005). Biology can be used to plug the "black box" of individual preferences.

Attempts to develop a scientific theory that integrates the natural and social sciences date at least as far back as the ancient Greek philosophers: Socrates spoke at length on the subject, Plato put it to paper, but it was Aristotle (Politics, Bk. I) who was able to articulate it concisely:

> "Hence it is evident that the state is a creation of nature, and that man is by nature a political animal. And he, who by nature and not by mere accident is without a state, is either a bad man or above humanity; he is like the "Tribeless, lawless, hearthless one" whom Homer denounces-the natural outcast is forthwith a lover of war; he may be compared to an isolated piece at draughts."

Seldom fully interpreted this quote goes to say that man by NATURE, not nurture is a political animal; furthermore man who is not by nature political, is no man at all. As Aristotle's work is often considered the foundation political theory, it appears one of his most important ideas have been largely ignored in the discipline.

Given the continual advances in genetics research and the introduction of the field of behavior genetics, according to E.O. Wilson (1998) the potential for a unified theory for both the social and hard sciences is within our reach. Richard Alexander, David Buss, Edward O. Wilson, Albert Somit, Leda Cosmides and John Tooby among others, have

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[19] The most recent examination of the genetic importance to political attitudes by Alford et al (2005) gives a convincing argument to this effect. They address the weakness in current political science research paradigms, both rational choice and behavioralism, and introduce evolutionary biology as an alternative theory. They propose that "Neither [rational choice or behavioralism] is a [complete] theory because neither provides an account of the reasons people are environmentally sensitive or are rational…"

led the way in combing evolution, biology, and social science to produce a theory for understanding human behavior and institutions (Wilson 1975; Somit 1976; Masters 1983; Masters 1990; Cosmides and Tooby 1994; Buss and Shackelford 1997; Summers 2005). In separate but intertwined scholarship they posit that human behavior is jointly a result of biological and environmental effects. The social sciences, particularly the study of political behavior, may benefit by building upon their works (Axelrod and Hamilton 1981; Thayer 2000; Orbell et al. 2004; Alford et al. 2005).

Evolution and biology appear to provide a more complete foundation for human political behavior as they are based on science and the examination of the interaction of humans and the environment, not solely on philosophical roots such as ego and metaphysics, or purely on environmental stimuli such as rational action and behavioralism. Biology and evolution include the organism and its ancestral development at the individual level, offering a foundation to build upon and sources of variation, whereas traditional social science environmental theories consider the organism in the same manner as Skinner's "black box" and only consider the current environment.

Consider the following thought experiment: we are by nature driven to do certain things; we must eat, sleep, procreate, communicate, have relationships, work together, etc.; the list is not a short one (Wilson 1980). We are social beings, and are meant to interact with one another. Why we do these things is not conferred upon us by our current environment. We do not need to eat because there is food; no matter what the environment offers, we must eat. Certain behaviors and attitudes are inherent regardless of stimuli. But not all things are solely biological. We may need to eat, but what if we have a choice? For certain some foods are more tasty than others, and if given a choice we tend to take the tastier food. The need and desire to eat is biological; even what we know to be tastier is not a choice (Bufe et al. 2005). But the choice of what to eat is partly biological and partly environmental—we cannot chose what is tastier to us, we cannot choose our need to eat, but we can choose to eat the tastier food if provided with options (environment), and without the external food options, there is nothing to react to. The "why" question then in its simplest form is a combination of both biology and environment. Yet, if we are observing a given subject in this scenario and we do not know our subject's inherent taste preference structure or where it came from, then to answer the question of why a subject choose to eat chocolate versus cauliflower in a given observed scenario only tells us that the subject chose chocolate; it does not tell us why the choice was made or what the real preference being observed is.

It would be considered strange in the scholarly community if one thought that people actually choose to have reactions to certain foods (lactose intolerance, allergic reactions, hives, visceral responses, etc.), yet a majority of social scientists hold this position when we replace food with attitudes. Somehow, it is acceptable to not have choice on taste preferences, but on attitudes we all fully rational cognitive thinkers (Lichbach 2003; Landermore 2004).

Now consider the "how" issue. What if there are two people but only enough food for one? How do we decide on the course of action to eat? Biologically humans have a drive to eat and the potential to use a wide array of actions necessary to ensure our survival. If one subject used force or violence to achieve these means, the rational choice explanation would be that one subject made a cost benefit analysis by using a game theoretic model to show the preferred outcome for the use of violence to coercion, cooperation or starvation; thus explaining nothing more than what was already observed. The behavioralist would posit that due to socialization, upbringing, and the scarcity of food, violence was the result. Now take a 10,000 of these scenarios. Why do some people, raised in the same environment, choose violence, while others choose cooperation? Following the logic of rational choice one would likely conclude it was their individual preference. In certain aspects this explains everything with nothing. Alternatively, the logic of behavioralism would conclude it was the given scenario and the individual's socialization; however, the behavioralist cannot account for the different reactions in the population with the same socialization and environmental conditions, or similar reactions in the population with different socialization and environmental conditions. In addition, neither theory can account for deviations from the norm. Could it be that some people simply have an inherent higher or lower threshold for using violence while others don't? Do mechanisms in our brain and internal chemical reactions mitigate, mediate or moderate our reactions to external stimuli? Refer to the vast majority of the scientific literature and the answer is a profound "yes!" (Dearden 1974; Caspi et al. 2002; Caspi et al. 2003; Coolidge et al. 2004; Meyer et al. 2004; Kendler et al. 2005; Lesch 2005).

In 2002 Avshalom Caspi and others examined a large sample of male children from birth to adulthood to determine why only some abused children develop antisocial (violent) behavior, whereas others do not. They found that the gene encoding the neurotransmitter metabolizing enzyme monoamine oxidase (MAOA) moderates the effect of childhood abuse. Children of the genotype with high levels of MAOA were less likely to be abusers than other abused children with low levels of MAOA. Several studies of similar fashion verified their findings, thus partly explaining why not all abused children grow up to victimize others, and that genotypes can moderate our sensitivity to environmental stimuli. In general, abused children do grow up to abuse, but when we filter out those with low level serotonin transmitters, the percent chance of developing into an abuser is much higher.

Of further importance, Caspi et al. (2002) finds that although children having the combination of low-activity MAOA genotype and maltreatment were only 12% of their sample population, they accounted for 44% of the sample's violent convictions. Even more startling, 85% of the males with a low-activity MAOA genotype who were severely maltreated developed some form of antisocial behavior compared to half that for high activity MAOA genotypes. Similar experiments examining depression, suicide and alcoholism provide converging evidence (Meyer et al. 2004; Kendler et al. 2005; Lesch et al. 2005). Clearly for human behavior, genes not only matter, but in certain cases make an enormous difference.

Based on the aforementioned scholarship, introducing an empirical biological approach to political science is significant for two reasons. First, biology offers a firm intellectual foundation for political behavior as the result of human development. Political behavior scholars can use biology and evolution to construct empirically falsifiable hypotheses and thus expand the discipline's explanatory capacity. Second, biology and evolution offer a more complete explanation of humanity by including humanity's physical being into the explanation of political behavior at the individual level. By contrast, political science's use of the standard social science model focuses only on the present environment without reference to the variability of the organism under observation (Lopreato and Crippen 1999; Alford and Hibbing 2004). Simply put, our current theories and examination assume all people are genetically the same.

Naturally political scientists may ponder how does this relate to our discipline, after all we are only "social" scientists? E. O. Wilson, Leda Cosmides, John Tooby, Richard Alexander, Albert Somit, Steven Peterson and others have shown that evolutionary theories provide the scientific anchor for the study of human behavior and human institutions, and some argue that evolution provides a basis for specific forms of government and state types (Somit and Peterson 1997).

Consider our typical model of vote choice. We gather several important social indicators, gender, race, age, income, education, ideology and so forth; we observe individual level voters, and using a large sample run an Ordinal Least Squares (OLS) regression, examine the coefficients and make generalizations. These models are not without merit; we do find statistical relationships worth reporting that provide insight on why people vote for who they vote for. Yet taking a look at the majority of political science's scholarly work we find that the R-squares are fairly low; so even though we find significant predictors, they aren't predicting very much (Matsusaka and Palda 1999).[20] Our traditional designs have several significant shortcomings that a biological and physiological approach can help overcome. In our typical analyses we have one model to explain all human behavior. Of course we are making assumptions or conclusions based upon means, but our models do not provide explanations as to why

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[20] Matsusaka and Palda (1999) employ logit regressions utilizing more than three dozen variables in multiple models of survey data for four national election years and find that using demographic and contextual variables provide significant effects on the probability of voting, but the models have *low* R-squares and do not predict who votes more accurately than random guessing.

when faced with different stimuli, people do the same things and vice versa. It is a question we cannot fully answer with only environmental factors in our repertoire.

Additionally, our current environmental models cannot clearly distinguish between different sources of environmental variation. For instance, numerous studies attempt to determine if voting is primarily based upon familial influence as suggested by the Michigan school, or rational action as proposed by Anthony Downs (1957). In doing this, the studies pre-assign the independent variables as either "familial" or "personal"; which is a very imprecise method as every variable contains both familial and unique sources of variation (see Neale and Cardon 1992 for more on variance components). For instance, items such as *income* are considered familial, while *peers* unique. By adding a genetic layer and controlling for familial biology we can parse out the different sources of a variation for each independent variable and its effect on the dependent variable, something that only theories and methods adhering to heritable or genetic possibilities can do.

Furthermore typical OLS models are structured so that all predictors interact in a horizontal fashion. There are relatively few structural models in vote choice research and of those the causal paths examined are those with social indicators that have clear longitudinal variables; education before income and gender before everything else, yet none include inherent traits.[21] For example, even though we know males and females are biologically different, the majority of the social science literature accounts for sex differences as socialized gender (Gilligan 1982; Chodorow 1978; Chodorow 1995). The biological difference is rarely if ever considered. In other words we control for gender without controlling for sex as well.

Using biology and the human organism as starting point for universal and individual attitudes, genotypes for sub-group universals and genotype matched with phenotypic traits for individual variation in the path model can offer a means to answer why sex provides variation before "gendered" socialization, and why we find further variation in a

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[21] After performing a thorough review of the most cited political science journals, structural path analysis is used infrequently at best in comparison to other models, and none utilized physiological inherent traits as starting points in casual path.

given subgroup when all other environmental considerations are constant. This latter benefit comes by adding a layer that allows us to make hypotheses and empirically test these hypotheses regarding individual physiological variation and expression of attitudes. The vast majority of current political science research ignores how different human beings are when examining human behaviors and attitudes. We truly categorize all people as a singular entirety, only differentiated by their response to survey questions regarding their opinions.

If we step away from the empirical research for moment and ask ourselves, does someone with Asperger's syndrome actually think and act the same as the "average" person when making everyday choices? Of course not, but Asperger's is just a small genotypic variation, a small genetic difference that can alter the entire set of behaviors. Now considering we have endless small differences in "average" people, the logical assumption would be that these average differences too affect our attitudes and behaviors in all things, including political attitudes. Using biological theories, we can test if small individual differences have an impact on one's response to external stimuli.

Imagine going doctor's office if you are feeling ill, and the treatment regimen only includes asking you about how you feel? The doctor conducts no physical examination, no bloodwork, and no lab tests. You would be very unfortunate if you had a real illness. Each licensed medical professional must assess both the expressed conditions and the internal physiological entity on an individual basis. Every other discipline that examines nonhuman behavior, whether primatologists, zoologists, or others, examine the subject's physiological nature as it interacts with the environment. The primatology literature is an excellent example; when researching the political aspects of the group, primatologists note the physiological makeup, whether it be the physical size and strength of Chimps or the color of a Monarch's wings, the organism is as important in explaining behavior as the environmental conditions (Waal 2002; Strier 2003). However, those who study human political behavior rarely if ever include the human physiological condition. Considering the above, and using only the traditional social science approach, study of political behavior has been relegated to be more political anthropology, or political sociology, instead of political science.

At the center of this examination is the longstanding philosophical question regarding the nature of basic human preferences and motivation. Countless theories of human's wants and desires have been offered over the centuries: Aristotle's "virtue", Rousseau's "social contract", Hobbes's *Leviathan,* or Maslow's "hierarchy of needs" just to name a few. However, these preference structures continue to maintain an almost arbitrary account of human nature. They lack a unifying theory that offers a reason as to why these various needs and desires exist, or how they are connected to one another (Cosmides and Tooby 1994). Arguing that the human preference structure should be approached from a biological and evolutionary perspective, this study includes our past development and immediate ancestry as the precursors to our current political preferences by examining our political decision making processes as potentially passed down from our parents.

Evolution by Natural Selection

It is widely agreed that the remarkable concept of evolution is vital to our welfare, medical advancements, and our understanding of the world in general. It is used by nearly all branches of science as the theoretical underpinnings of scholarly work; whether it is geology, climatology, primatology, or oncology- the list is endless (Economist 1997; Werner 1999; Alexander 2004; Wilson 2005; Ramaswany et al. 2006). Evolution is the foundation of biology and is a complete theory for individual, societal, institutional and natural development and existence. The main tenets are not so complicated that they cannot be used by non-biologists; rather evolution as a theory can be used by any scholar with minimal investment (Wilson 2002). Most importantly, the evidence that evolution exists is overwhelming, widespread across species, increasing in breadth and depth, and interconnected with almost all disciplines of study (Economist 1997; Quammen 2004; Wilson 2005). Evolution by natural selection is accepted as fact in the scientific community and is now embraced by economists, the discipline that once championed rational choice (Axelrod and Hamilton 1981; Economist 1997; Robson and Kaplan 2003).[22]

The two main concepts of evolution are 1) the interconnectedness of all life, the evolution of all species coming from a common ancestry, and 2) natural selection as the means driving evolution; thus, traits are passed down from our ancestors. Although the evidence supporting evolution is conclusive, the first concept remains a question of great debate among those not in the scientific community, and while possibly worthy of further examination it is a question for another time and another study and has little impact on modern political examinations.[23] The second main concept of evolution, natural selection, is not of great debate; it is a reality among those in the scientific, medical and professional fields and is the guiding theory for the entire field of biology. It is accepted as mainstream thought in the public, mass media, pop-culture, and academic circles (Buss 1995; Futuyma 1985; Futuyma 1986; Lander et al. 2001; Aach et al. 2001).[24] While examining the impact natural selection has on political traits in novel, it may also not be relevant. The important component for political study is that traits are passed down from our ancestors. This is the concept explored in detail in this examination and the point of focus. Heritable traits can be empirically tested and do account for individual variation.

Charles Darwin (1859) proposed that organisms of the same species that differ from others in ways that increase their number of offspring in comparison will inevitably leave a greater number of descendants in following generations with those same

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[22] Some of the recent winners of the Nobel Prize in economics were behavioral economists, who promote other than rational behaviors influence decision making. Robson and Kaplan (2003) adopt an alterative view of the relationship between economics and biology. Rather than viewing human biological characteristics as effectively exogenous determinants of economic phenomena, they develop an empirical argument that considers how the economics of hunter-gatherer societies shaped economically relevant human biological characteristics by means of natural selection.

[23] The basis for this belief is the finding that there is common genetic material (DNA or RNA) that do the same things found in different organisms, including humans, animals and plants. Therefore, it is hypothesized that all organisms are descended from a common source.

[24] The evidence to support natural selection and evolution in general is remarkable. See Nature, February 15, 2001 for results from the Human Genome Project). Also see Gunter and Dhand (2002) editor's note on the mouse genome effort, where they find that 99% of house mice genes have direct counterparts in humans. For natural selection examples, see Rice and Chippendale's (2001) lab experiments involving scores of generations of the fruit fly; also see Lenski et al's (2003) experiment involving 20,000 generations of the bacterium Escherichia coli. Pop Culture hits such as the *Sopranos* even address the topic of "genes" regularly in their first season.

(heritable) traits. The concept is that small, random, heritable differences among individuals result in different chances of survival and reproductive success. The development of such heritable differences leads to a process of gradual species change that is "evolution by natural selection." In its simplest sense, organisms that possess heritable traits for reproductive success will inevitably indirectly ensure that they and their offspring are more reproductively successful than others who do not possess heritable traits for reproductive success; thus over time increasing the number of organisms in that species with the particular advantageous reproductive traits and those traits that are associated with the advantageous reproductive traits. Thus, the relative percentage of the number of organisms without the advantageous reproductive traits will decline.[25]

An important and common misperception is that Darwin's theory of evolution by natural selection inevitably and principally predicts "the survival of the fittest". This term was coined by Herbert Spencer, years before Darwin's *Origin of Natural Species*. By examining Darwin's literature it appears it was a term he may not have been comfortable with; in Darwin's follow-up to the *Origin of Natural Species*, the *Descent of Man*, he made only two mentions of the "survival of the fittest", but almost 400 about love, moral sensitivity, the brain and the mind.[26] The organism is not adapting, but the species as a whole is. In this sense "filtering" might be the more appropriate word than "adaptation."

It must be clear that not all heritable traits are survival or reproductive traits; rather our genes are linked in countless ways and we can inherit numerous preferences, behaviors, and physical conditions that are not optimally survival traits or related to reproduction or fitness (offspring). It is very possible that only certain traits are ultimately survival or fitness traits, while all other traits linked to those are also passed

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[25] In most species natural selection will inevitably "phase" out the genotype that does not maximize reproductive success. However highly successful organisms such as humans do not necessarily face this scenario. As humans are the most adaptable and successful sentient organism on the planet and have been able to alter their environment on a global scale (birth control, medical advancements, etc), humans have the greatest genetic variation and are not readily subject to phasing out, more likely that high reproductive success genes will dominate, but not completely overtake other genotypes. Humans have in effect been able to alter the evolutionary design, by ensuring those with less survival traits actually survive.

[26] Darwin adopted the phrase from Spencer to summarize the process of natural selection, not to define it.

down, thus providing endless variation of the majority of traits, while little variation for others (consider the immune system as a survival trait, and fingernail ridges as a linked trait).

The theory of evolution that I and others (see Hibbing and Alford 2004; Alford et al. 2005) propose to build a model of human political behavior on is not one which adds assumptions or draws inferences to human behavior other than that offered by the downstream effects of Darwin's evolution. Evolution acts through genes, but it also acts on the relationship between genes and the environment. The environment is as much a part of the process of evolutionary inheritance as are genes.[27]

To be clear, this examination does not equate evolution with just survival selection. Differential reproductive success linked with differences in heritable traits, not different survival success, is the core of natural selection. Survival is important to the extent that it is required for reproduction, but individual survival may not be the primary drive for natural selection (Buss 1988). Furthermore, many of the traits that are evolved or heritable, may have little reproductive advantage, rather they are traits linked to those with reproductive advantage, which most humans already have.

Not Your Mother and Father's Social Darwinism

> "In relation to the intellectual and moral faculties of man. These faculties are variable; and we have every reason to believe that the variations tend to be inherited. Therefore, if they were formerly of high importance to primeval man…they would have been perfected or advanced through natural selection. Of the high importance of the intellectual faculties there can be no doubt, for man mainly owes to them his predominant position in the world. We can see, that in the rudest state of society, the individuals who were the most sagacious, who invented and used the best weapons or traps, and who were best able to defend themselves, would rear the greatest number of offspring. The tribes, which included the largest number of men thus endowed, would increase in number and supplant other tribes. Numbers depend primarily on the means of subsistence, and this

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[27] Natural selection is ultimately a matter of reproductive success and species survival, but it is a large misconception that natural selection favors the "fittest" in the common sense of the word, or that evolution by natural selection implies progress to a superior form of life (Badcock 1991). Generally natural selection only asserts that heritable tendencies leading to greater reproductive success are enough to explain evolution; however I do not want to give the impression that evolutionary theory is about reproduction in the narrow rather than the broadest sense; any behavior could be a potential means for reproductive advantage depending on how successful it is in the current environment. Actions such as warfare or cooperation although likely to be opposites, could be used in different circumstances to pursue the goal of survival or mating and therefore be considered adaptive (Badcock 1991; Gat 2000a &b; Quammen 2004).

> depends partly on the physical nature of the country, but in a much higher degree on the arts which are there practiced. As a tribe increases and is victorious, it is often still further increased by the absorption of other tribes. The stature and strength of the men of a tribe are likewise of some importance for its success, and these depend in part on the nature and amount of the food which can be obtained" (Darwin 1871: 128).

For many people including political scientists, it is immoral and unscientific to connect biology and human behavior (Ledger et al. 2001). Sadly humanity has a history misusing Darwin's name and work to suit its own racial and gender biases (Hudson 2001). However, evolution is not the Spencerian social Darwinism that justified the sterilization of minorities and the poor, or the horrific eugenics movements that attempted to justify the inferior status of any who are not wealthy white males (Landman 1932; Selden 2000). Nor is it an exercise to explain why some people are superior to others, or have a better lot in contemporary society.

Spencer developed his social Darwinism by applying evolution to capitalism, social class, and human society. In this view people got what they deserved, not in the Weberian protestant view, where effort and morality were concerned, rather Spencer's decisive factor was a matter of genes. Those with the fittest genes flourished in modern society, whereas the poor, uneducated and lower class were unfit and failure in life was their fate (Moore 1903; Hofstadter 1955). But Darwin's evolution by natural selection (including modern interpretations of Darwin) is far from those things.

The process of natural selection is based upon adaptive traits beginning at a much earlier period in human development, where pure economic power seeking and self interest were not the only potential adaptive traits (they may not have been adaptive at all). In fact, we must take into account the central role of cooperation and trust in human evolution. Collaboration is an adaptive trait, particularly for related individuals. Numerous studies show that it takes enormous incentive to motivate one to "sell out" family members, particular with those whom they share a significant amount of genes (Trivers 1971; Axelrod and Hamilton 1981; Kruger 2003). Trust is adaptive and though strongest for family members, also allows for cooperation with those to whom we are not related. This is unique to humans, our ability to track others behaviors and know who and when to trust, and when to punish (Economist 1997).[28] This skill, our capacity to "identify a large number of individuals and to keep score of its relations with them, detecting the dishonest or greedy and taking vengeance, even at some cost to itself" is an evolved one (Gintis et al. 2003).

For certain the evolution of our species is directly related to our success as a whole, but our universal or individual genetic adaptive traits may likely have little bearing on modern day success within our society. We cannot confuse our species' success with individual success, nor can we confuse our species' source of evolved attitudes with individual ones. This leads to the central difference from Spencer's view; in order to accept evolution as an explanatory theory for human political behaviors and attitudes, it is proposed that we look for individual variation, as well as identify cross-cultural universals, regardless of personal success (Buss 1989; Buss 1994). If evolution is to be a universal theory for political behavior, first we explain the similarities humans share through population studies, and only then can we attempt to explain sub-group and individual variations in these universal themes with genotypic analyses (Flinn and Low 1986). Therefore, it is in these universal themes and sub-group universals in specific populations for a specific time frame that we should find a genetic relationship and heritability of political attitudes. Once we add genotyping data we can make individual level inferences. The relation between the environment, culture and individual variability is mediated by our underlying genetic makeup, which has been formed by our ancestors past selective forces (Wilson 1975).

The challenge we must overcome by incorporating biology and evolution into political science is greater than just fear of the self serving and erroneous logic of social Darwinism. To some degree accepting biological theories as the starting point for human behavior challenges religious and personal belief systems; particularly that of free will. The theological depth of this discussion can be a volume in and of itself, but also can be explained in a single sentence. The use of evolution and biology as sources of preferences does not necessarily imply the lack of rational cognition or free will, only

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[28] Outside of humans and certain other primates, only vampire bats trust non-relatives (Wilkinson 1984).

that the foundation of our decision processes, and where our "rationality" comes from, is as important as the options we are presented. It is no coincidence that one of the founders of behavior genetics is also an ordained and active priest! While some assert that free will is just another form of measurement error when examining environmental and genetic determinants (Martin 2006), others propose free will is built-in humans by our physiological design. Until further sustained evidence can rule out one of the alternatives, there is room for the full spectrum of theoretical designs to examine using evolution.[29]

Biology may give us the beginning of why we want what we want and the internal process and preferences we have; while our lives, upbringing, society and personal experience can alter those things to varying degrees. How we go about making choices, although not uninfluenced by our biology, is still a matter of personal choice, but the preferences for those choices, and the processes for how we go about making choices are mediated by our internal and external conditions.[30]

The final barrier to overcome is that from the discipline itself. Emil Durkheim (1895) claimed sociology was a distinct and independent discipline; social behaviors could only be explained by social indicators. It is remarkable how this view has continued to persist today among political scientists in light of the prolific scholarship available to us in the information age.[31]

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[29] Expansive multigenerational family studies with genome wide association scans that link behavior to genes and control for familial socialization, appear to be the most likely candidate to provide more definitive separation of error and free will.

[30] For instance, style, such as whether we take lots of risks is heavily heritable, and affects personal decision making!

[31] The hostile reaction to the use of evolution in political study is not limited to the written scholarly discourse. At a recent Midwest Political Science Association conference I was approached by an academic inquiring about this line of research; that is examining the potential for heritable behaviors using evolution as a theoretical foundation. Basically, we get our looks (eyes, facial features, height, etc) from our parents, so why not the potential for certain behavioral patterns, once we control for the environment. As I was speaking to this academic, I explained the research in terms that clearly ruled out eugenics or genetic determinism; rather we are attempting to explain more of the variance in behavior, not all of it and not in a fatalist manner. Her response was, "so you are doing the same things the Nazis did…ok I got it…you're no better than the Nazi's." I did not expect this reaction from academia, and hope to believe it will be an anomaly, but I fear it may be the norm. My example is anecdotal, but considering the recent creationist versus evolution debate building in public education again, it may be more representative than I'd like to think (Witham 2005; Boston 2006). These types of challenges will be the most difficult to overcome, and

Considering societal norms and behaviors are created by human beings and assuming rational choice as given, that human decisions are ultimately products of the rational cognitive part of the brain, if the brain has evolved and is inherited from our ancestors, which there is evidence of, human behavior and social norms must also have evolved and be passed down (Lumsden and Wilson 1983). Yet the inclusion of our physiological structure as an indicator of human behavior continues to be rejected, feared and ostracized in the social sciences (Ledger et al. 2001).

Current Social Evolutionary Theories and Why They Don't Work

The use of evolution as an explanatory theory for human social behavior has been gaining steady momentum since the 1970's with increased attention in the 1990's to the present day. The most notable of these paradigms are Evolutionary Psychology, Evolutionary Developmental Psychology, and recently Evolutionary Social Science. Regardless of the specific theme to which one may subscribe to, they all use a common foundation based upon evolution and natural selection (Buss 1995; Cosmides and Tooby 1997; Barber 2005). Evolutionary psychology (EP) is the most commonly used and for sake of brevity, the following is a brief summarization of EP.[32]

Evolutionary Psychology (EP) asserts preferences are not simply inherent, but inherent because of our ancestor's ability to solve adaptive problems. The basic tenet of EP is that human behavior mechanisms evolved to solve adaptive problems that our species faced in the hunter gatherer period. Therefore, preferences come from our

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the only way to overcome them is to continue to produce scholarly work, using the most robust methods and being clear about the conclusions (and often lack thereof) in our findings.

[32] Evolutionary development psychology (Bjorklund 2001) and evolutionary social science (Barber 2005) offer different wrinkles on the EP theme, but all three theories share a common ancestor in sociobiology; as sociobiology pioneered the use of the same basic evolutionary theories of natural selection and inclusive fitness. However, Sociobiology and evolutionary behavior theories have a significant difference. Sociobiology adheres to the belief that the goal of human mechanisms is to maximize their inclusive fitness; to maximize their gene representation in subsequent generations (Alexander 1990; Buss 1995). Sociobiology describes functional relationships between key variables such as population density and reproductive success, and builds models that describe competition, and cooperation, and evolution. Whereas sociobiology examines relationships that apply across species, Evolutionary Psychology examines the human species specifically. Evolutionary behavior theories, such as evolutionary psychology differ in that they posit fitness varies across sex, age, and other environmental factors. Successful adaptations can and will vary from the plains to the coasts (Buss 1995). As such evolutionary psychology explicitly eliminates the concept of genetic determinism, whereas sociobiology, however incorrectly, is often believed to infer it.

interaction with the environment over-time and are passed on to our offspring who utilize these inherent abilities in our day to day actions on an almost unconscious level. Our simple tasks only seem simple because our proficiency in solving them is genetically passed on and unnoticed. Tooby and Cosmides (1990) posit that "Both the psychological universals that constitute human nature and the genetic differences that contribute to individual variation are the product of the evolutionary process." As EP proposes using these standards for examining evolutionary hypothesis regarding personality, some have posited that political scientists too can use these ideas to do the same for political behaviors, potentially providing a means to offer insight in human political preferences as ones derived or mediated by our evolutionary adaptive traits (Tooby and Cosmides 1994).

The earliest proponents of evolutionary behavior theories claim every personality phenomenon is analyzable as either (1) an adaptation, (2) by-product of adaptations, (3) noise in the system, or (3) some combination of thereof (Symons 1979; Tooby and Cosmides 1990). Therefore, EP identifies cross-culture universals of human behavior, not individual differences or sub-group differences.[33] An important clarification is that although many evolved traits still work in human's survival and reproductive best interests today, not all evolved traits maintain their usefulness in reproductive success. Match.com, Target, condoms, and machine guns were not readily available in Hunter-Gatherer (HG) societies. The human preference for high sugar, high fat, high calorie foods was definitely adaptive to HG life; but access to this type of food was not commonplace, but it is today. However, today high fat and high sugars may very well be maladaptive; as too much could result in high cholesterol or diabetes (Johansen an Edgar 1996; Tattersall 1998; Kaplan et al. 2000; Bjorklund and Pellegrini 2001).

Evolutionary Psychology theorists posit that 99% of our history as humans developed in hunter-gatherer societies and this hunter-gatherer (HG) period shaped the human decision making process today (Cosmides and Tooby 1997; Gat 2000a). Thus our ability

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[33] EP asserts that such universal human characteristics may have different expressions in different societies dependent upon culture.

to mitigate the problems of today are only adaptations of our skills evolved from the past HG way of life that shaped human behavior over approximately 2 million years of development (Tooby and Cosmides 1990; Barkow et al. 1992; Buss 1995; Buss 1999).[34] To be clear, they are not evolved skills, but adaptations of previously evolved skills. However this inherently leads to a dilemma for future proof of our ability to evolve. If the majority of human existence took place in the hunter gatherer (Pleistocene) period, then it is from this time that we must look to examine the source of our modern preference structures.

The Pleistocene period was stable for a very, very long time, whereas our current environment changes rapidly. Thus, following the logic of EP, there is too much time needed to observe real-time empirical evidence of human evolution in progress. Thus, EP is limited; as it cannot be utilized for models that consider modern or more rapid cases of human evolution. Although we may not know for certain how Hunter Gatherers lived, archeological, anthropological, and contemporary observations of modern day hunter–gatherer societies serve as models of human societies prior to the development of agricultural societies and provide populations for examination (Oota et al. 2005).

Patterns of genetic variation in HG groups such as the !Kung and African Pygmies exhibit low genetic diversity coupled with high frequencies of divergent DNA types not found in surrounding population groups, thus suggesting long-term isolation, small population sizes, and strong heritable and evolved development.[35]

Using anthropology and evolutionary literature it may be possible to construct a theme of basic attitudes and behaviors that would be adaptive traits. Any attempt to examine if evolutionary selective pressures have a relationship on political attitudes would require a sample of humans in the hunter gather period, and some hypotheses suggesting behaviors that are most closely associated with what hunter-gather (HG) man

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[34] Evolutionary Psychology utilizes the hunter-gatherer hypotheses to generate predictions about human behaviors by specifying physiological systems that solve an adaptive problem. Rather than assuming the independent evolution of individual components that just happen to work together, EP starts with the adaptive problem to be solved and what physiological requirements would be needed to solve it.

[35] Additionally, examinations of other life forms that have reduced time spans have produced empirical and reproducible evidence that evolution does take place (see Rice and Chippendale's 2001; Gunter and Dhand 2002; Lenski et al's 2003).

encountered should be highly heritable (if we are to have evolved as species and a majority of our evolution occurred in the HG environment). However, findings in the evolutionary literature with regard to selection pressures are often imprecise, as is the knowledge of the environment that HG societies faced, and while the theory of natural selection can be rather simple, linking current behaviors and attitudes to past selection pressures is not. Clearly our society today is much more complex than that of the early hunter-gatherer period and therefore it is not readily apparent how we can empirically answer how it is that yesterday's brain is solving today's problems. Thus linking every possible contemporary individual attitude and behavior to a past selection pressure is not plausible and would be highly speculative at best.

Regardless, even if we could perform tests of such hypotheses, these types of examinations have limited merit in traditional political studies, and add very little explanatory capacity such as why someone votes the way they do. In effect, if the findings are truly universal as proposed by the tenets of EP they may only have a one time scholarly benefit with little avenue to build upon. In other words, the theory offers no means to explain individual variation- which is what political scientists do! Thus, while EP provides a theory for human behavior that includes our humanity, the theory is difficult to use for empirical research outside of experimental simulations; and though it may provide a nice foundation to generate hypotheses, it is not well suited for political science. At worst, it appears to simply be a better "just so" story.[36] This doesn't not meant that EP is entirely without merit, but the reliance on the dearth of HG societies, and ones which arguable may not represent our ancestral HG societies, provide formidable roadblocks. Even if access to these societies was possible, the questions we

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[36] In numerous laboratory settings subjects are consistently found to not act according to the dictates of rational choice theory. Experimental evidence has shown punishment of non punishers provides the biggest impact on cooperation, and third party punishment, or our perceived good will and cooperative attitudes are superior survivability traits and are passed on (Fehr and Fischbacher 2003); which is why humans are more cooperative in comparison to other species. Gintis et al (2003) finds humans maintain a predisposition to cooperate with others and punish those who violate the norm of cooperation, even at a personal cost or when there is no expectation that they will recover the cost of punishing. These experiments are important to EP because scholars cannot monitor human evolution in progress or go back to the hunter-gatherer period and conduct field observations. As such experimental evidence provides the only empirical support that certain human behaviors are frequently anything but rational cognition.

would like to answer may not be easily translated from these cultures to ours, nor would the results be generalizable.

Furthermore EP limits evolution to the Pleistocene, and does not include more modern cases of human evolution and miscategorizes the pace of evolutionary change. There is considerable evidence evolution is taking place in modern life and not at a pace consistent with the EP literature (Economist 1997; Quammen 2004). This is the most problematic facet of EP- the foundation upon which it was built; that humans derived their modern thought processes in the Pleistocene and it is with these "caveman" brains and process that we translate into modern day preferences and behaviors. EP makes a huge leap assuming that stability in environment slowed down evolution or at least equates to evolutionary change always being slow. In fact this is the opposite of what evolution is. Species evolve as their environment evolves; as our modern day environment revolves rapidly, so should species that interact with it. While it is true the Pleistocene was stable for tens of thousands of years, EP offers no evidence why evolution only takes place in spans just as long. In fact evidence contrary to their assertions is consistently provided in the natural sciences. In short, while the concept is novel, it offers little explanatory capacity for modern individual behaviors and little opportunities for empirical research.[37] So we are faced with a dilemma, how do we utilize evolution and biology to empirically examine human political behavior if not EP? How can we test the evolution of political attitudes?

I contend the answer may be utilizing modern Biometrical Theory and methods from Behavior Genetics.[38] Using both family studies and genotypic data matched with behaviors, Biometrical Theory offers a means to test if certain behaviors and attitudes are in fact heritable and once genotypic data is collected linked to specific genes. The central problem EP and evolutionary designs face is to tie behavior to evolved traits, and while difficult to match current behavior with grandiose hypothesized selection pressures,

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[37] For an example of the difficulties of testing hunter gatherer evolutionary hypotheses see Freese and Powell, (1999) and (2001) and Kanazawa (2001).

[38] The behavior genetics literature typically does not explicitly address evolution as the theoretical underpinning, it is assumed. In addition, the literature focuses on both individual genetic variation as well as population norms.

behavior genetics can begin to show that certain behaviors and attitudes are passed on from our ancestors (heritable); thus providing powerful evidence that evolution in its simplest form (political traits passed on from our ancestors specifically) is empirically falsifiable. Biometrical Theory and Behavior Genetics provide the empirical link between evolutionary theory and political behavior. Furthermore, once genotypic data is collected, we can begin to confirm theories on evolutionary survival traits. It could simply be that certain political expressions are side effects of genes that are superior for immune system strength or longevity. Or we may come to find, that politics are not a side product but a survival mechanism itself! Being a political scientist, I hope for the latter. In addition, behavior genetics offers the potential to make assumptions about groups, sub-groups and individuals, and is not limited to making inferences about the entire human species as a whole. It provides a means to explain variation among humans, something EP ignores.

Evolution and Heritability as a Source of Political Attitudes

John Dearden (1974: 24) provides a very concise but thorough explanation of evolution and political behavior:

> "Briefly, according to evolutionary theory an organism interacts selectively with its environment within the limits, capabilities, and motivational states inherent to the species and the individuals' morphology, physiology, psychology, and social behavioral patterns. Inherited capabilities, structure, and dispositions comprise an integrated system which enable species to interact adaptively with their environments. Behavioral response-sets and the environmental stimuli which activate them may be quite specific or rather generalized, depending on the evolutionary history of the species, and an understanding of the behavior of any species, it is argued, requires that the behavior be approached from an evolutionary perspective. From this perspective even that behavior which typifies the highly organized human social structure is viewed as a behavioral form resulting from a continuous evolutionary process that is genetically and culturally shaped according to evolutionary origins, and in particular to those adaptive survival strategies that met our species need…the environment is considered to include certain social stimuli or "social releasers" which trigger generalized response patterns…**Therefore man as a political being can be seen as exhibiting behavior that is considered to be a product of social conditioning, or socialization, and of inherent biologically transmitted response-predispositions."**

The most important action for political scientists is to not accept biological or evolutionary paradigms blindly as some of those who accept rational choice or behavioralism, but to treat the paradigm as fallible and testable. It is certain that many behaviors are inherited and likely so are many preferences; but not all behaviors or preferences may be subject to evolutionary pressures or genetic discrimination. To express such caution does not mean that I dismiss that all behaviors have the potential for genetic and heritable foundations, rather I choose not to take the blinded social science approach that everything is “rational” or everything is “behavioral” or everything is “evolved.” Rather, the solution is to get a clearer and better-defined set of biological mechanisms to explore the extent to which they are relevant to specific modern political behaviors. Furthermore, biometrical theory and the twin method specifically (the twin method will be explained in detail in chapter 3 provides a means to partition out environmental variance into that which is common to members of a family or social group and that which is unique to the individual, thus allowing political scientists a technique to examine different sources of preferences and validate existing environmental theories, genetic variance withstanding.

Evolution accepts the importance of the environment as adaptations that are passed on, are only done so as reactions to the environment. Thus, in the face of similar genetic traits, humans often have different preferences and behaviors. As a populace we have certain similar inherent characteristics, as individuals we share certain genetic traits. The question for political scientists is whether the combination of these with the environment of today translates into identifiable political behaviors and preferences? To examine the individual variation within our species using biological paradigms we are required to find genetic similarities with observed or self identified preferences. Without behavior genetics methodologies the options are limited. However, utilizing biology as our theory, and behavior genetics as our model and methods, political behavior research has the opportunity to examine the biological, physical and environmental sources of political preferences and behaviors, for a given population and at the individual level.

So how does evolution and behavior genetics mesh with the study of political behavior? The field of evolutionary models of political behavior is relatively new, and not until the 1960’s was it deemed a potential subfield (Somit 1976). Although the number of scholars adding to the literature continues to rise, evolutionary politics and the biology of politics remain a small and seldom addressed subtopic. However, although the field is relatively small, the research undertaken and the importance of the findings are growing in magnitude. Recent studies have shown that political behaviors are in part heritable and subject to evolutionary designs (Martin et al. 1986; Eaves et al. 1989; Orbell et al 2004; Alford et al. 2005). Most of these were twin studies which were primarily designed for reasons other than the study political behavior; as such most of the twin studies only devote a small portion of the questionnaire to assess political opinion. Although these surveys are somewhat limited, significant heritable relationships are evident. Opinions on abortion on demand, immigration, death penalty, euthanasia, conservatism, and authoritarianism as well as behaviors such as being a leader, religiosity, and educational attainment have been found to be strongly heritable; while religious affiliation and political partisanship are primarily environmental (Martin et al. 1986; Eaves et al. 1989; Crelia and Tesser 1996; Eaves et al. 1999; Olson et al. 2001; Bouchard and McGue 2003; Bouchard et al. 2003; Alford et al. 2005).

Alford et al.'s (2005), Eaves et al. (1999), and Martin et al.'s (1986) findings that heritability can explain up to 50 percent of the variance in political attitudes is a stunning revelation. Clearly environment is not everything. In a majority of the political items examined, the heritability coefficient was over .20 (out of 1). These findings should be of the utmost interest to political scientists. Adding a heritable component to the study of vote choice where vote choice is not simply a function of one's issue positions, party affiliation, or level of information, but rather those elements being influenced by one's genetic makeup, would require the discipline to readdress the examination of vote choice as a whole. Introducing a more complete model including both environmental and heritable factors may help further explain why some people vote, others don't, and why people choose certain issue positions in the face of similar environmental or social stimuli.

However, population universals only tell a part of the story. As noted earlier, humans are remarkably individually diverse; our genetic code varies greater that any other species (See Nature, February 15, 2001 for results from the Human Genome Project). In order to explain individual human variations we can also use Behavior Genetics association and linkage technique which examines individual human differences by analyzing individual genes or groups of genes combined with environmental conditions, culture and exogenous stimuli when measuring a specific trait.

A complete theory for political science then is to incorporate our traditional environmental theories of rational choice and behaviorism, with a biological theory to test hypotheses about population universals, sub-group universals and individual biological variability; thus building a foundation for political behavior by using the methodologies of behavior genetics and political science which specify sources of variation (both individual and population based) once external forces and population universals are filtered out. Once a trait is deemed to be genetically heritable, we can then use association and linkage to identify specific genes for individual phenotypic (trait) variance.

Going from Theory to Empirical Design: Behavior Genetics and Heritability

So how do we test our hypotheses using behavior genetics? For this we initially examine and utilize twin studies. It is has been widely accepted that a significant number of physical, physiological and behavioral traits including the propensity for certain health conditions are the ultimate result of a complex interaction between inheritance (genes) and the environment (Caspi 2002; Bouchard and McGue 2003; Mattick 2004). It is a common observation in many studies that to a large degree, family members resemble each other in many traits, attitudes, and certain health conditions (Eaves et al. 1998; Happonen et al. 2002; Krueger et al. 2003; Jansson et al. 2004).

By studying the difference between Monozygotic (identical) and Dizygotic (fraternal) twins it is possible to estimate the relative importance of genetic versus environmental influences, and to discriminate between common environmental (familial socialization) and unique environmental (personal experience) forces.

Although the twin data were initially used for health and other physiological studies, the heritable component in a wide range of human behaviors has increasingly been examined. Attitudes such as sociability, dominance and self acceptance have been found heritable (Olson et al. 2001). An abundance of studies on personality finds converging evidence that personality traits (neuroticism, extraversion, openness, agreeabless and conscientiousness) are heritable (Neale et al. 1986; Jang and Livesley 1996; Saudino 1997).[1] Beatty et al. (2001) even finds communication traits such as social composure (.88), wit (.90) and social confirmation (.37) are heritable; while articulation and appropriate disclosure are not heritable.

Even more interesting than the heritability of high level personality traits are the heritable dimensions found in specific behaviors. Sexual orientation, depressive symptoms, post traumatic stress disorder, alcohol consumption and reading have heritable significance (Bailey et al. 1993; True et al. 1993; Olson et al. 2001; Happonen et al. 2002; Jansson et al. 2004). These are just a small sample of the heritability findings in the twin studies; the literature is vast and growing, and ranges widely.

While this chapter covered a very wide range of theoretical designs and previous literature, biometrical theory and behavior genetics methodology is not simple and requires a chapter dedicated to the topic specifically. The following chapter will provide the theoretical underpinnings and methodological processes used in behavior genetics with particular attention the classical twin design, which is the main method of analyses used in this work.

Chapter 3 –Behavior Genetics: A Methodological Introduction[39]

Dr. Jennifer Melfi:	Genetic predispositions are only that, predispositions; its not a destiny written in stone. People have choices. You think that everything that happens is preordained? You don't think human beings possess free will?
Tony Soprano:	How come I'm not making pots in Peru? You're born to this shit, you are what you are.
Dr. Jennifer Melfi:	Within that there is a range of choices. This is America.[40]

While the discipline begins to incorporate biological influences as explanatory factors in political behavior (see Alford et al. 2005) the need to present a methodological road map for utilizing twin data and biometric genetic theory in general is apparent. The classical twin design (CTD) is the most popular design in behavioral genetics used to examine the source of variance among social and political behaviors and is the main design utilized in this study. The CTD has strong roots in biometrical genetic theory, and provides estimates of the correlations between observed traits of identical (monozygotic) and fraternal (dizygotic) twins in terms of underlying genetic and environmental components. The majority of theses analyses utilize structural equation models (SEM) of observed covariances for both twin types to assess the relative importance of these 'latent' factors. SEM programs estimate model parameters by minimizing a goodness-of-fit function between observed and predicted covariance matrices, usually by the maximum-likelihood criterion.

This chapter will provide a clear framework for the use of twin data in political study, and as such I concentrate on the univariate classic twin design (CTD), however multivariate methods including Cholesky decomposition are also addressed. Behavioral genetics is predominantly taught as a graduate or post-graduate discipline, drawing students from a wide range of backgrounds including genetics, psychology, and

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[39] Portions of this chapter are under review as a manuscript in Medland and Hatemi (2007).

[40] Courtesy of HBO's the "Sopranos".

mathematics as well as the medical and biological sciences. However, in writing this chapter I have attempted to present the rationale and methods at both conceptual and theoretical levels for the basic use of behavior genetics in the study of political science.

Central Concepts Underlying the Twin Model

Typical family studies are limited in their ability to discriminate sources of variation, genetic from environmental and/or social upbringing; in the social sciences family resemblance in a given social or political trait is typically assumed to be due to shared family environment such as social class instead of genetic factors. In response, adoption studies have been utilized and shared environment or genes can be controlled for if adoption occurred during infancy. However the dearth of available data due to the need to protect the child and mother combined with the potential of selective placement, limits adoption studies in their application to political traits. Classical twin studies can overcome both of these shortcomings.

The twin method derives its explanatory power from the fact that monozygotic (MZ) twins develop from a single fertilized ovum (which divides within 3-4 days of fertilization), whereas, dizygotic (DZ) twins arise from two different ova fertilized by different sperm. Genetically, MZ twins are identical; whereas DZ twins share only 50 percent of their genes; genetically they are no different than ordinary siblings born at different times.[41] Twins are raised by the same parents, in the same environment and at the same time thereby acting as controls for the effects of familial socialization. Thus, if a given trait were heritable and influenced in part by genetic effects the co-twin correlation of MZ twin pairs would be higher than that of DZ twin pairs. If we expected to find no additive genetic component, the co-twin correlation of monozygotic twin pairs should be roughly equal to that of dizygotic twin pairs

Behavioral genetic techniques have developed in an attempt to understand individual differences: that is, to understand why individuals in a population differ from one another. The measured value of the trait under examination for each individual

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[41] It is possible for identical twins to differ genetically due to mutations that arise in the copying of DNA. Identical twins may also differ in the activation of their genes due to hormones released in-uteri.

(known as the *phenotype*) is expected to be due to both genetic and environmental effects.[42] Behavior genetics research differs from most social science research through the use of family data. While the goal of traditional social science examinations are to sample independent randomly selected individuals, behavior genetics approaches deliberately samples non-independent data from related individuals drawn at random from the population (Neale and Maes 2006). This sampling strategy violates the assumptions of independence implicit in the majority of statistical tests, including correlations, regression and ANOVA measures. Because of this, analyses of family data must explicitly model the non-independence (relatedness) present within the data. These analyses are usually undertaken using maximum likelihood structural equation modeling techniques, although other methods such as repeated measures ANOVA or Bayesian modeling are sometimes used.

The most common approach to modeling twin and family data is known as the *variance components approach*. By analyzing data from relatives researchers partition the variance into that which is *shared* between relatives and that which is *unshared* or unique to the individual.[43] This partitioning of variance is analogous to the partitioning of variance (or sum of squares) into within and between factors that occurs when using ANOVA techniques. While estimating the relative magnitude of shared and unshared effects is of interest, it does not provide information regarding the sources of the shared variance. That is we could conclude that the trait runs in the family (it shows *familial aggregation*) but we could draw no conclusion about whether this similarity has arisen due to genetic effects passed from parents to offspring or as a consequence of a shared socialization process.

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[42] Typical phenotypic traits on political science would be vote choice, party identification, and each attitude in general on political issues. In model terms, the phenotypic trait under observation would be the dependent variable. The term “environment” is commonly used to account for all stimuli that are not of a genetic origin such as ones friends, exposure to crime or poverty etc.

[43] Unique environmental influences represent differences in trait values between members of a family due to individual differences in the experiences and perceptions of events, illnesses or injuries. Socially, they may include the effects of experiences with romantic partners, employment and peers not shared with a co-twin or sibling. However, also subsumed within this source of variance are influences that may come from differences in the perceptions or attributions of experiences shared with other family members. Measurement error is also subsumed within this source of variance.

One can further partition the *shared* variance into that which is due to genetic effects and that which is due to the family or *common* environment using simultaneous equations if data collected from relatives who differ in the amount of genes they share or the extent to which they share the family environment is available.[44] Arguably, the most common designs used in behavior genetics are the twin design (where data is collected from identical and non-identical twins including opposite sex twin pairs) and the twin and sibling design (in which data is collected from twins and also from any non-twin siblings). Of these two designs the twin and sibling design is superior, as it increases power to detect shared environmental effects and allows an empirical test of several assumptions implicit within the twin model including a more robust test of the equal environment and sampling assumptions (described in more detail later in this chapter). In essence, twins and their siblings provide a natural human experiment and the use of twin designs allows researchers to disentangle the influences of genetic and environmental factors for a specific behavior.

The proportion of variation within the trait due to genetic effects is described as the *broad sense heritability* (H^2).[45] However, while broad sense heritability estimates can be used to demonstrate the presence of genetic effects, they are limited as they provide no information about which genes are influencing the trait or the way in which the genes act. Generally when modeling genetic effects in the absence of measured genotypes, it is possible to distinguish two broad classes of gene action, additive and non-additive (dominant), based on the patterns of covariation between relatives.[46]

A genetic effect is described as additive if the cumulative gene effect is the sum of the individual effects of all of the genes involved. This type of gene action leads to a distinctive pattern of covariance between different types of relatives whereby the genetic covariation between DZ twins (or between twins and a non-twin sibling) is half that of

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[44] Common environmental influences are those that are shared by family members or cultural group and typically include traditional sociological variables such as socioeconomic status, parental influence, access to education and health care. However, common environmental influences can also include more biological variables such as nutrition and exposure to household toxins such as lead.

[45] Note the term *heritable* can be used to describe a trait where $G \neq 0$.

[46] Genotype refers to the physical material (DNA) passed on by parents at the moment of conception.

MZ twins. That is, if a trait were solely influenced by additive genetic and unique environmental effects the correlation between DZ twins would be expected to be half that of MZ twins.

Conversely, a genetic effect is described as non-additive if the cumulative gene effect deviates from the sum the individual effects of all of the genes involved. Non-additive gene effects arise from interactions either with a gene (known as *dominance*) or between genes (known as *epistasis*). In other words, all genes do not always act in an additive manner, but may interact. As such, it is required to include in the genetic value a measure of this interaction. Interaction between alleles for a single locus that results in phenotypic expression that is not purely additive is referred to as the Dominance deviation or (D). Interactions between genes at different loci that act on the same trait are referred to as epistasis.

Covariation due to non-additive genetic effects depends on a relative inheriting the same copies of the gene and acts to reduce the covariation between DZ twins and sibling pairs who inherit the same copies of a gene about a quarter of the time as compared to MZ pairs who always inherit the same copies of a gene. If a trait were influenced by additive and non-additive genetic effects as well as unique environmental effects the correlation between DZ twins would be expected to be less than half that of MZ twins.[47]

Common or familial environment effects also create a distinctive pattern of covariation. As it is assumed that the extent to which the common environment influences a trait will be the same for both MZ and DZ twins and their non-twin siblings, common environmental effects increase the similarity of DZ twins and siblings relative to MZ twins. This assumption known as the equal environments assumption is the most commonly criticized aspect of twin studies. It is important to note that it should not be assumed that the MZ and DZ twin pairs share equally similar environments; a common mistake made by scholars in the social sciences. Rather, that common environment

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[47] As it is assumed that more than one gene will influence the trait, and non-additive effects represent interactions while additive effects represent main effects.

equally affects all offspring in the family (both twins and any siblings after correcting for age and sex differences) with respect to the trait under observation.

Thus, common environmental effects act to increase the DZ correlation relative to the MZ correlation, while non-additive genetic effects have the opposite effect. When working with data collected from MZ and DZ twins who were reared together (i.e. both twins grew up in the same household) these two sources of variation (additive and dominance) are confounded and can not be estimated within the same model. The addition of data from twin pairs or additional full siblings who grew up in different households with limited interaction, or data from half-siblings or unrelated individuals raised as full-siblings could be used to disentangle these sources of variance. In the absence of such data one would usually fit a model in which the sibling covariation is due to additive genetic and common environmental effects, known as an *ACE* model if the DZ correlation was at least equal to half the MZ correlation. Conversely if the DZ correlation was less than half the MZ correlation one would usually fit a model in which the sibling covariation was due to additive and dominant effects, an *ADE* model. Both common environmental effects and dominant genetic effects may be acting on the same trait. However, without additional familial data this can not be determined.

Twin and Family Data Modeling Techniques

Early twin studies (from the 1900s to the 1970s) concentrated on using differential equations to estimate proportions of variance due to additive genetic (A), non-additive genetic effects (D), common environment (C) and unique environment (E) effects from the MZ and DZ correlations. The methods are referred to as Falconer transformations (see Falconer 1960). Following these methods one may estimate A, C, D, and E as follows:[48]

$A = 2*(r_{MZ}-r_{DZ})$ assuming $D \cong 0$

$C = 2*r_{DZ}-r_{MZ}$

$D = 2*r_{MZ}-4*r_{DZ}$

$E = 1 - r_{MZ}$

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[48] Dominance deviation (D) is addressed in more detail later in the chapter.

This style of data analysis is severely limited in its application. These methods were designed to deal with continuous normally distributed data and cannot correct or covariates effects (age, etc.). Nor can Falconer transformations be applied to multivariate data; furthermore a large amount of information (means, raw variances, etc.) is lost by only considering the correlation structures, thus reducing the power to detect small but significant effects.

In addition, studies using the Falconer method typically do not include data from opposite sex twin pairs. Without data from the opposite sex pairs it is impossible to test whether the genetic or environmental effects estimated for males and females stem from the same sources (sex limitation). That is, even if A were estimated at 20% for both males and females, without data from the opposite sex pairs one would not be able to conclude that the same genes influence the trait in both sexes.[49] If the same genes were influencing a trait to the same extent in males and females then the correlation between the male and female genetic effects (rG) would be one. If rG differs from 1 then it may be concluded that males and females differ in the magnitude of genetic effects or the source of these genetic effects, or both the source and the magnitude of effects. However, this hypothesis can only be tested if data collected from pairs of opposite sex relatives is present; without these data we cannot estimate rG. By modeling the raw variances and covariances of female-female, male-male and opposite sex twin pairs one can not only test whether the same genes (or environmental influences) are affecting males and females, but also test to see if the absolute magnitude of these effects is the same between the sexes.[50]

More modern methods of twin studies began to emerge in late 1960s and early 1970s. As typified by the seminal papers of Eaves (1969; 1977) and Martin (1977) these papers focused on structural equation modeling of variance-covariance matrices. Using the “newly” emerging punch card computers to develop a range of more complex analytical techniques drawn from the factor and path analyses, these scholars were able to model multivariate and longitudinal data, interactions between genetic and environmental

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[49] This concept is explained in greater detail later in the chapter.

[50] It is possible for the genes affecting the trait or for the magnitude of gene effects to differ between males and females. The most obvious examples are genes that are located on the sex (X and Y) chromosomes.

effects and various types of sex differences (among others). Increases in computational power and access have allowed the modeling of raw data for both continuous and ordinal variables for a wide range of complex traits. Behavioral genetics as a field has focused on the development of models that more accurately reflect the complexities of human behavior and development. To this end there is a focus on explicitly modeling the effects of covariate and interaction effects rather than correcting for these effects prior to modeling the data. More recently technological advances (both computational and in terms of laboratory techniques) have led to the integration of genetic information derived from lab based DNA analysis into models to allow researchers to hunt for the actual genes that are influencing behavior.

Arguably, structural equation modeling within a maximum likelihood framework is the most common approach to data analyses in contemporary twin and family analyses. Using the maximum likelihood approach minimizes the goodness-of-fit between observed covariance and mean/prevalence matrices and those predicted by models of genetic and environmental. Conceptually speaking this optimization procedure considers how well the model fits the data for a range of parameter values and arrives at the solution (converges) when it finds the parameters that produce the lowest log likelihood. The parameter values that produced the optimized solution are estimates of the magnitude of these 'latent' sources of variance (ACDE). The reliability of these estimates is usually expressed as 95% confidence intervals, which are the positive and negative deviations from these estimates that result in a change in the fit of the model (minus twice log likelihood, -2LL) of 3.64 (equivalent to $\chi_1^2, p = .05$).

It is possible to test the effect of dropping parameters from the model by comparing the fit of the model in which the parameter is freely estimated to the fit of the model in which the parameter has been set to zero (known as dropping the parameter). The difference in model fits, assuming that the models are nested (one model is a sub-model of the other) is asymptotically distributed as a chi-square distribution with the degrees of freedom equal to the difference in the number of estimated parameters between the two models. For example to compare the difference in fits between an ACE model (in which the covariation is due to additive genetic and common environmental effects) and a CE model (in which the covariation is solely due to common environmental effects) against a χ_1^2 distribution, drop the A parameter from the saturated (full) model. However, there can be not direct comparison of the fits of an ACE model with an ADE model as these models are not nested.

Modeling Mean (Continuous) or Prevalence (Ordinal) Data

When analyzing family data one must specify the model that will be fitted to the variances and covariances. In addition, when analyzing raw data it is necessary to provide a model for the means (or prevalences in the case of ordinal data) which can include the effects of covariates such as age, social economic status, time or season of data collection etc.[51] When modeling continuous data information from three sources of information are present; the mean, variances and covariances of each subgroup within the sample[52]. When modeling ordinal data one typically employs the multifactorial liability threshold model which assumes that the ordinal data collected is an indirect and imprecise measure of an underlying latent trait (typical referred to as the distribution of liability) that has not been, or cannot be, measured precisely.[53] Instead, liability is measured as a series of ordered categories, characterized by phenotypic discontinuities that occur when the liability reaches a given threshold.[54] The multifactorial liability is assumed to reflect the combined effects of genes and environmental factors (Neale and Cardon 1992). This

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[51] While not readily apparent to most social science examinations, time of day and season can influence physiological mechanisms which influence behavior. One such example is the effect sunlight has on serotonin levels which affect depressive symptoms (Lansdowne and Provost 2004).

[52] In these models the data from each of the five types of twin pairs (MZ male, MZ female, DZ male, DZ female and opposite sex twins) are simultaneously modeled as a separate data subgroups each with their own expected means/prevalences and variance/covariance structures. When preliminary analysis has shown that there are differences in the means, variances and covariances (for continuous data) or for the prevalences and covariances (for ordinal data) these five zygosity groups are sometimes condensed into two groups MZ and DZ.

[53] Many such examples can be found in the American National Election Studies questionnaire, which requires the respondent to answer questions that cannot be measured continuously, rather they must choose from a set of options ranging from Strongly Agree to Strongly Disagree (Sapiro et al 2002).

[54] In studies of disease traits these threshold usually represent the division of “affected” from “non-affected” individuals. Depending a an individuals position on the liability continuum gets closer to the threshold the non-affected individuals may be expected to show a increasing number or severity of symptoms until finally there are sufficient symptoms or severity to for the individual to be diagnosed and they are categorized as affected.

underlying continuous latent variable is usually assumed to follow a standard normal (z-score) distribution[55] (unless corrected for) which allows the prevalence of each ordered category to be expressed in terms of cut points, expressed as z-scores, which divide the distribution. Under this model difference in thresholds between subgroups or samples imply differences in variances.

To illustrate this point the following is an example from Hatemi et al.'s (2007) analyses of voting data in a sample of Australian twins. Between 1988 and 1990 a range of data including which party individuals usually voted for was collected. Given the predominantly two party system within Australian politics the data was effectively reduced to a binary variable; those who voted for the more conservative Australian Liberal/National Coalition and those who voted for the less conservative Australian Labor Party. The binary variable of vote choice could be viewed as an indirect measure of the voters' overall ideological issue position on the grounds that voters choose between the parties on the basis of their issue platforms and that these platforms represent positions on an ideological scale. Of the 94% of participants who voted for one of these two main parties 57% voted conservative. As shown in Figure 1, this prevalence can be mapped onto an underlying hypothetical distribution and expressed as a z-score of 0.175.

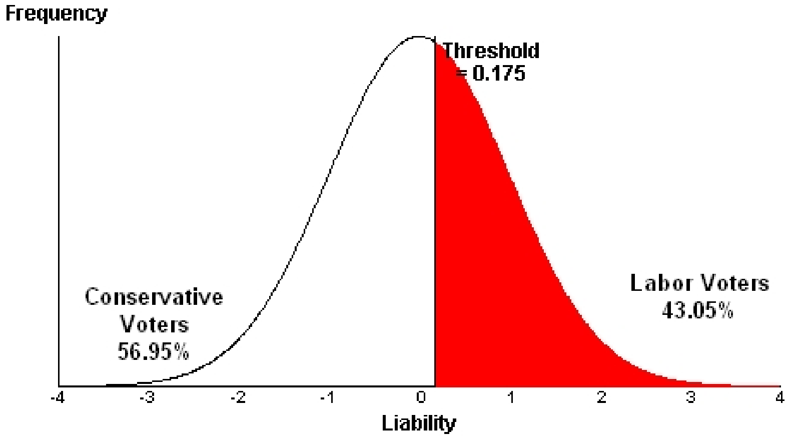

Figure 3.1 - a normal distribution of ideological position with the cut point imposed

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[55] However other distributions can also be hypothesized. Note this model is strictly ordinal in nature and can not be applied to nominal data with more than two categories.

The main advantages of working with thresholds are that they directly map onto current conceptualizations of the cumulative effects of genetic and environmental influences. An additional convenience of this approach is that when analyzing data under the threshold model the variances of the variables are set to 1, this means that the estimates of variance effects (A, C, and E) are standardized estimates, which means they can be easily compared across samples.

Visual Representations of Models

It is common for behavior geneticists to provide visual summaries of their models through the use of schematic path diagrams. Figure 2a below presents the path diagram for a univariate ACE model. These diagrams follow the conventions of path analysis:

1. Squares or rectangles are used to denote observed (measured) traits.
2. Circles or ellipses denote latent (unmeasured) variables.
3. Upper-case letters are used to denote variables.
4. Lower-case letters (or numeric values) are used to denote covariances or path coefficients.
5. Single-headed arrows or paths are used to represent hypothesized causal. relationships between variables (the causal variable is the source of the arrow).
6. Double headed arrows are used to represent covariances between variables (the source of this covariance need not appear in the model) or the variance of an exogenous variable (i.e. the covariance of a variable with itself).

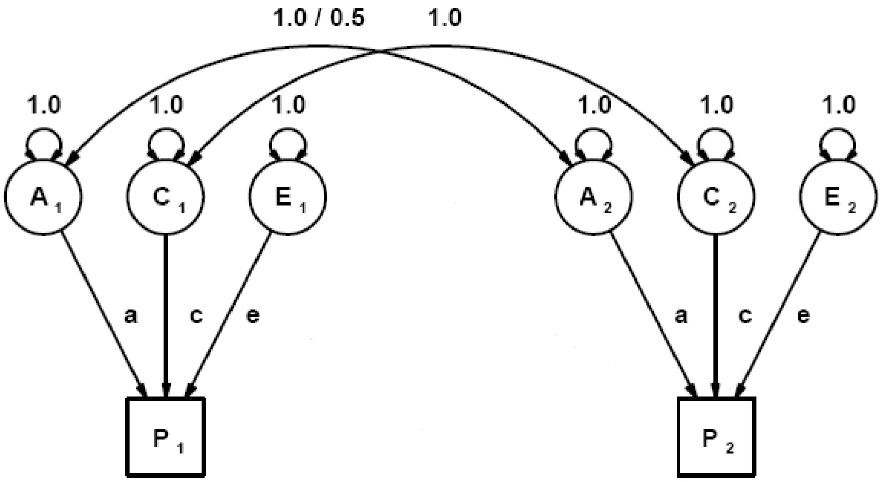

Figure 3.2a- an ACE path diagram with labeled paths

Path diagrams provide an explicit representation of the model which allows the model parameterization to be replicated through application of the following rules:

1. The expected covariance between two variables, or the expected variance of a variable, is computed by multiplying together all the coefficients in a chain, and then summing over all possible chains.
2. Trace backwards, change direction at a 2-headed arrow, and then trace forwards.

Applying these rules to the ACE model (Figure 2a) we can see that the variance for a MZ twin is calculated as: (a * 1 * a) + (c * 1 * c) + (e * 1 * e) = $a^2 + c^2 + e^2$. Figure 2b gives the ACE model from the analyses of Australian voting data explained in detail in Chapter 5. Following from this diagram we can see that at the population level additive genetic effects accounted for 24% of the variation in vote choice.

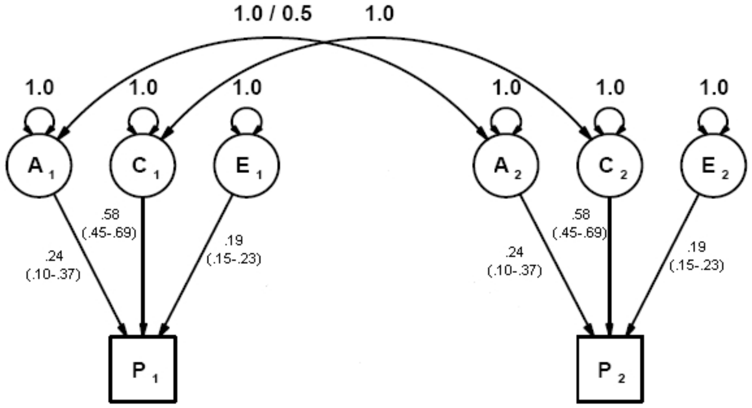

Figure 3.2b - an ACE diagram for vote choice in the Australian vote choice data

Aside from providing an explicit summarization of the model, path diagrams are also a helpful tool for translating theoretical models into the matrix algebra used in structural equation modeling. For example, following from Figure 2 a we derive the following algebraic statements for the variance/covariance matrices of MZ and DZ twins:

$$\text{Variance covariance matrix} \begin{bmatrix} \text{Var. twin1} & \text{Cov. twin1\&twin2} \\ \text{Cov. twin1\&twin2} & \text{Var. twin2} \end{bmatrix}$$

$$\text{MZ} \begin{bmatrix} a^2+c^2+e^2 & a^2+c^2 \\ a^2+c^2 & a^2+c^2+e^2 \end{bmatrix} \qquad \text{DZ} \begin{bmatrix} a^2+c^2+e^2 & .5*a^2+c^2 \\ .5*a^2+c^2 & a^2+c^2+e^2 \end{bmatrix}$$

Statistical and Theoretical Assumptions

As with all statistical analyses these approaches depend upon several key assumptions.

Distributional Assumptions

As with many statistical approaches, it is assumed that continuous data will be screened for outliers normally distributed. Furthermore it is assumed that the distribution of cross twin values, that is the value of twin 1 plotted against the value of twin 2, will be bivariate normal. This can be checked by examining each family’s contribution to the overall fit of the model and the influence of each family’s values using a metric such as the Mahalonbis distance. While the maximum likelihood approach is fairly robust in the face of minor deviations from normality if the data under analysis is seriously skewed or kurtotic transformation is suggested, alternatively significance tests can be obtained via permutation.

Representative sampling

It is assumed that all participants in the sample have been collected from the same populations using the same recruitment methods (unless otherwise specified). As estimates of genetic and environmental effects are population specific, it is important to ensure that sub-groups within the sample drawn from different ethnic, socio-economic or regional strata are controlled for. We would usually check this assumption by comparing the sub-groups for pertinent demographic variables.

Homogeneity Assumptions

When analyzing continuous data generic models of twin and family data assume that there are no differences in the means and variances between the different subgroups within the analysis. A similar assumption is made regarding the prevalence or thresholds for ordinal data. If such differences exist and are not accounted for the results of the analysis may be biased. Fortunately, it is not difficult to customize a model to account for these differences. Thus prior to fitting models to a given data set researchers typically run a series of preliminary analyses known as *assumption checking analyses* to the homogeneity of means and variances or prevalences within the data.

To run assumption checking analyses start by fitting a *saturated phenotypic model* to the data. In this model each of the five zygosity groups (MZM, MZF, DZM, DZF, DZOS) are modeled as a separate subgroup with its own mean/threshold and variance/covariance estimates. For continuous data, the means of the first and second born twin are allowed to differ, resulting in the estimation of ten means parameters. Similarly the variances and covariances are also allowed to differ between first and second born twins resulting in the estimation of ten variance and five covariance parameters. When analyzing ordinal data we allow the prevalences to differ resulting in the estimation of ten sets of thresholds and five covariance parameters.[56] Following a step-wise procedure fitting the series of models summarized as linear contrasts in Table 1, it is possible to simultaneously test if all ten means, variances or thresholds could be set to be the same.

Table 3.1: A linear contrast table outlining the standard assumption checking analyses for means, variances and thresholds. Assigning the same number to two estimated parameters indicates that they have been set to be equal within the model.

Model	**I Saturated**	**II 1st vs. 2nd Born**	**III MZ vs. DZ - Same Sex**	**IV OS vs. Same Sex**	**V Males vs. Females**
Estimated Parameters					
MZF1	1	1	1	1	1
MZF2	2	1	1	1	1
MZM1	3	2	2	2	1
MZM2	4	2	2	2	1
DZF1	5	3	1	1	1
DZF2	6	3	1	1	1
DZM1	7	4	2	2	1
DZM2	8	4	2	2	1
DZOS-F	9	5	3	1	1
DZOS-M	10	6	4	2	1
The fit of this model is compared to the fit of …					
Model	-	I	II	III	IV
Δ df	-	4	2	2	1

When data have been collected from non-twin siblings it is possible to test an additional model to check for differences in the means/variances or thresholds of twins

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[56] The variances are non-estimates and are fixed to 1 as under the multifactorial threshold model the ordinal data has been mapped onto a standard normal distribution with a variance of 1.

and their siblings. Note that any covariates, such as age, should be included in the model prior to testing these assumptions.

Generic models of twin and family data also assume the covariances will be the same within zygosity groups (no sex differences in the covariances). To test this prior to model fitting preliminary analyses on the covariances are also performed. Two different types of sex differences may occur, thus it is one would test for sex differences within same sex twins (testing for *non-scalar* sex differences) before testing whether the opposite sex covariance differs from the same sex DZ covariance (testing for *scalar* sex differences). These two types of sex differences will be described in more detail in the following section. In addition to checking for sex differences typically researchers also check for evidence of genetic or familial effects by comparing the MZ and DZ covariances, and then setting all covariances to zero (i.e. testing for any evidence of covariation between relatives). These models are summarized as linear contrasts in Table 2. When data has also been collected from non-twin siblings an additional model (between models III and IV) is tested which checks for differences between the DZ correlation and the twin-sibling and sibling-sibling correlations.

Table 3.2: A linear contrast table outlining the standard assumption checking analyses for covariances. Assigning the same number to two estimated parameters indicates that they have been set to be equal, or equated, within the model.

Model	**I Saturated**	**II M vs. F -**	**III OS vs. Same Sex**	**IV Genetic effect (MZ vs. DZ)**	**V Familial effect**
Estimated Parameters					
MZF	1	1	1	1	0
MZM	2	1	1	1	0
DZF	3	2	2	1	0
DZM	4	2	2	1	0
DZOS	5	3	2	1	0
The fit of this model is compared to the fit of …					
Model	-	I	II	III	IV
Δ df	-	2	1	1	1

Equal Environments

Broadly speaking, it is assumed that the contribution of any familial or common environmental influences will not differ between siblings with respect to the trait under analysis. More specifically it is assumed the magnitude of shared environmental effects on the trait under analysis will not be influenced by zygosity. That is, the shared (common) environment is hypothesized to influence the trait in the same way and to the same extent for MZ and DZ twins. This assumption has been subject to intense and repeated scrutiny and remains a source of much debate in the social sciences. The central concern is that the influence of shared environmental effects may be larger for MZ than DZ twins, or alternatively that there is an additional common environmental effect specific to MZ twins. If this were the case and the model did not accommodate this difference the proportion of variance due to genetic and environmental effects would be biased and the heritability of the trait would be over estimated, while the common environmental effect would be underestimated.

MZ twins are treated more similarly than DZ twins, as children they more often share a bedroom and are dressed alike, they are more likely to share common friends and stay in closer contact once they leave home (Cohen et al. 1973; Scarr 1968; Loehlin and Nichols 1976; Kendler et al. 1987; 1992). However, depending on the school attended they may be more likely to be placed in different classes, and more likely to compete for pre-natal nutrition leading to increase rates of growth disparities and complications in early childhood. The central question of the equal environment assumption is whether these differences influence the specific trait under analysis. While in some cases the answer may be yes, when considering the types of variables of interest to political scientists it is difficult to imagine that those who influence the development of our social, moral and political attitudes (including parents, peers and teachers) would either actively or subconsciously try to instill more similar values in a pair of MZ twins, as compared to DZ twins.[57]

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[57] A separate but related concept, *genotype by environment correlation,* describes the possibility that MZ twins may make more similar choices about lifestyles, friendships and life experiences than DZ twins. To the extent that these choices may lead individuals to spend time in environments that influence their trait values, which could result in differences in environmental effects between MZ and DZ twins. This situation although similar does not result from a violation of the equal environment assumption and will be described further in the following section.

Several methods have been proposed to test the equal environment assumption. As people tend to base the decision about whether twins are identical or not based on appearance the following methods have focused on perceived zygosity:

1. **Correlating perceived similarity with the trait while controlling for actual zygosity**. studies examining personality, intelligence, and personality disorders have found twin trait resemblance is not substantially influenced by physical similarity (Plomin et al. 1976; Matheny et al. 1976; Scarr and Carter-Saltzman 1979; Kendler 1983).
2. **Direct observation of family members and others to examine their self-initiated and twin-initiated behaviors towards the twins.** Lytton (1977) found that the more similar parental treatment of MZ versus DZ twins was entirely "in response" to the twin's behavior, not because of their "twin-ness."
3. **Correlating the similarity of the twins environments with the trait while controlling for actual zygosity**. Numerous studies have applied this method finding no significant correlation between environmental similarity and similarity for personality, intellectual ability, anxiety depression, and alcoholism (Loehlin and Nichols 1976; Kendler et al. 1986; Martin et al. 1986; Heath et al. 1989; Kendler et al. 1992). [58]
4. **The fourth method takes advantage of the fact that people frequently make incorrect decisions about the zygosity of twin pairs and many twins themselves are unaware to their actual zygosity.**[59] This discrepancy between perceived and actual zygosity is used to extend the classical ACE model by further partitioning the common environmental effect into the usual common environment effect, $C_{residual}$, which is completely correlated for all twin pairs, and that which influenced by the perceived zygosity, $C_{specific}$,(which is parameterized to be completely correlated if both twins perceive themselves to be MZ, completely uncorrelated if both twins perceive themselves selves to be DZ and correlated at .5 if the twins disagree about their perceived zygosity). Utilizing this method, numerous studies find no significant evidence that perceived zygosity influences twin trait resemblance (Scarr 1968; Matheny 1979; Scarr and Carter-Saltzman 1979; Kendler et al. 1993). Converging evidence supports Kendler et al. findings for other psychiatric disorders, drug and alcohol dependence, depression, and post traumatic stress (Hettema 1995; Xian et al. 2000).
5. A simpler statistical test which tests if **equating the thresholds between MZ and DZ twins** provides a better fit to the data than separate thresholds is often utilized

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[58] The limitation of this method, as Lykken et al (1990) have pointed out, is that a correlation between frequency of adult contact and phenotypic similarity in twin pairs need not be a causal one. Degree of phenotypic similarity could also influence frequency of contact.

[59] Scarr and Carter-Saltzman (1979) found that of their sample of 400 adolescent twins only 60% were correct about their own zygosity. More recently, Kendler et al found 80% of their sample of 1030 adult twins were correct about their zygosity, with the vast majority of twins basing their decision on either appearance or what their parents had been told at their birth.

> when the data collected is ordinal. If equating the thresholds for MZ and DZ twins is a better fit than allowing separate thresholds for DZ and MZ twin pairs, then in effect, it implies no differences in variances between MZ and DZ twin pairs.

In addition, when data have been collected from non-twin siblings checking for differences in the variances or threshold between twins and siblings and for differences between the DZ covariance and the twin-sibling and sibling-sibling covariances can provide an additional test of the broader definition of the equal environment assumption. Arguably, if the more similar treatment of MZ twins were affecting their trait values, one might also expect the more similar treatment of DZ twins, as compared to regular siblings, to affect the trait values of the DZ twins. As there is no difference in the genetic similarity of DZ twins and regular siblings one might conclude that after correcting for the effect of age any differences between the DZ twins and the non-twin siblings was due to some kind of twin specific effect such a violation of the equal environment assumption. However, most authors describe this test more generally stating they are testing for twin specific effects and do not explicitly state that a violation of the equal environment assumption is one of the types of twin specific effects that is being tested. This analysis has been conducted more frequently and for a wider range of traits than any of the four tests described above. As may be expected differences have been found for traits such as birth weight and perceived closeness to siblings. However, these differences have not been observed for intelligence, personality or social and political attitudes.

The equal environment assumption is not easily cast aside, nor should it be. However, it should be recognized that this assumption needs to be tested in a trait specific manner and that while a violation of the equal environment assumption invalidates the use of the classical twin model for that specific trait it does not invalidate the twin study approach in general and the CTD is not the only model that can be applied to the data. Quite simply, a researcher in this situation is advised to *explicitly* model non-equal environments. Unfortunately typical social science challenges to the equal environment assumption tend to either misrepresent the concept or generalize; suggesting that a violation to this assumption means the twin study approach to data analysis is flawed and its results can not be trusted (see Richardson and Norgate 2005). These critiques tend to avoid reviewing the contemporary literature. There is also a trend suggesting that a violation for one trait implies violations for a range of other traits without explicitly testing that this is the case. While it is not unreasonable to hypothesize an equal environment violation for a specific trait such as dressing alike, such a hypothesis does not advance the literature if it is formulated in such a way as to make it untestable, nor if there was never any intention that the hypothesis should be tested.[60]

Genotype by Environment Correlation

Genotype by environment correlation (r_{GE}) refers to the hypothesis that an individual's genes may influence their exposure to certain non-random environmental stimuli. In effect, one is choosing their environment based on their genes. This correlation may be classified as active, where the individual's own genes influence their exposures to certain environments, or passive in which the environment of an individual is influenced by the genes of a relative. Unmodeled active r_{GE} may either inflate (positive correlations) or deflate (negative correlations) the estimates of genetic effects. Traditionally longitudinal data have been required to test these effects. Unmodeled passive r_{GE} may increase the estimates of common environmental effects[61]

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[60] Using a purely theoretical/philosophical attack on the equal environment assumption as a way of refuting twin studies is unlikely to have an impact on the acceptance of the findings within the general public or scientific community because of the repeated use of this strategy. Researchers wishing to use this challenge are typically advised to back up their supposition with data.
One such critique of the equal environment assumption (Richardson and Norgate 2005) does not address recent findings and methods to test the equal environment assumption; rather the authors quote recent research when citing the importance of the equal environment assumption, but use empirical evidence from 10 years past. While other scholars challenge the equal environment assumption using methodological approaches that are not empirically accepted (see Freese and Powell's (2003) critique of Horwitz et al's (2003) model. Even more disturbing is Horwitz et al's (2003) assertion that "theoretical assumptions not empirical findings determine where to end the chain of causation between social and genetic factors." Statements such as these lends strong credence that social science critiques of behavioral genetics methods are no more than a means to challenge the theory and in effect denigrate social science to social philosophy.

[61] Some scholars posit that studies finding a significant heritable relationship may actually be underreporting the heritability effect. Saudino (1997) finds genetic factors contribute to many measures that assess the environment; the environment is not independent of the individual as the individual plays an active role in creating their own environment. In other words, more than just behavior is heritable, as there may be a heritable tendency for some to enter certain situations (Caspi et al 2003). Not only are family physical traits heritable, but the family environment is heritable, and mate selection increases heritable effects (Eaves et al 1989; Eaves et al 1999; Krueger at al 2003;). What this would amount to is a

Previously these effects have been modeled using data from biological and adoptive families. A relatively recent method proposed by Purcell (2002) has allowed researchers to test for and model r_{GE} using twin and family data assuming that some measure of the salient environmental influences has been collected. The rGE moderator model effectively estimates the effects of the environmental influences on the variable of interest and estimates the residual A, C and E effects after the variation due to the environmental influences has been partialed out.

Genotype by Environment Interaction

Genotype by environment interaction (G*E) arises when individuals with different genotypes differ in their response or sensitivity to the environment. The presence of G*E means that the estimates of genetic and environmental effects will differ within the sample based on salient environmental influences. If the salient environmental influences are not shared among the siblings the estimate of unique environmental effects will be inflated. While shared environmental influences will inflate estimates of additive genetic effects. Traditionally the presence of G*E has been assessed for by testing for a correlation between the sum and absolute differences of data from MZ co-twins (i.e. heteroscedastisicity). More recently the method of Purcell(2002) has allowed researchers to test for and model G*E using twin and family data assuming that some measure of the salient environmental influences has been collected. The G*E moderator model estimates the proportion of A, C and E for the variable of interest partialing the effects into that which is linked to variation within the environmental influence and that which is unlinked or residual.

Tryon’s (1940) experiment on maze-running ability in rats provides an excellent example. After seven generations of selecting “bright” and “dull” lines of rats by selectively breeding the best and worst maze runners with like rats Tryon produced two lines of rats with remarkably different maze running ability. Clearly the difference was genetics as the offspring of the two lines were raised under identical typical lab

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compounding effect of heritability. While environment shapes our preferences, the environment we select may be heritable, thus directing us to a certain environment that influences our attitudes and behaviors (Scarr and Carter-Saltzman 1979).

conditions. However after a single generation, in which rats were raised in an environment with more stimuli the difference in maze running ability disappeared (Cooper and Zubek 1958). In essence maze running ability in rats was the product of a gene-by-environment interaction, where the genetic effect was only present under certain environmental conditions.[62]

Zygosity Testing

In general the majority of models assume the zygosity status of twin pairs is known. Arguably the best test of zygosity is provided by genotype data. The behavior genetics field commonly uses the same panels of high polymorphic markers that are used in forensic DNA testing. Blood provides the most easily processed and high quality sample for DNA testing. However, salvia and cheek swab samples can also be used. In the absence of biological samples, concurrent evidence from zygosity questionnaires, blood grouping, and photographs can be used to establish zygosity with a reasonable degree of accuracy (above 95%).[63] Recently models have been developed which allow researchers to model uncertainly in the zygosity diagnosis.

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[62] An important assumption implicit in the social science literature is random mating. However, this assumption is not made in most biometric studies, rather it is assumed that mating is assortative. The effects of assortative mating are present in near all disciplines, even political science (see Stoker and Jennings (1989). For more on assortative mating on social behaviors in the social sciences see Kalmijn (1994), in psychiatry see Merikangas (1984), and in behavior genetics see Vandenberg (1972) Heath et al (1985) Heath et al (1987) and Eaves et al (1989).Assortative mating refers to the tendency for individuals to chose romantic partners who are similar to themselves and thus have higher genetic and environmental correlations. Currently social science research assumes random mating for the traits under observation or does not see selective mating on political/social traits as relevant to their analyses. Those in behavior genetics discipline know this not to be the case (Martin et al. 1986; Eaves et al. 1998; Eaves et al. 1999). Hypothetically, when two individuals who are similar for the trait of interest have children this may increase the genetic similarity of the siblings for the trait of interest so that genetic sharing of DZ twins or regular siblings will be greater than .5. Such an effect would lead to inflation in the estimation of common environmental effects. However, this presupposes that the phenotypic similarity of the parents is due to the effects of the same genes. Given that the number of genes influencing complex behaviors is expected to be very large and similar trait values may arise through multiple genetic and environmental causes, it is difficult to know the extent to which phenotypic assortative mating influences the genetic sharing of offspring. The presence of a significant correlation between the parents for the trait of interest provides an indication of the presence of assortative mating.

[63] The two most common questions used to determine zygosity are: 1) As children, were you and your twin mistaken by people who knew you? and 2) Non-identical twins are no more alike than ordinary brothers and sisters. Identical twins, on the other hand, have such a strong resemblance to each other in stature, coloring, facial features, etc., that people often mistake one for the other, or say they are ‘as alike as two peas in a pod’. Having read the above statement, do you think you are an identical twin

Univariate Considerations

When reporting the results of univariate analyses for publication scholars typically report the co-twin correlations for each zygosity group and discuss the selection of either an ACE or ADE model based on these correlations. The fit statistics and the absolute estimates or the standardized estimates (relative proportions of variance) with their 95% confidence intervals (or both sets of estimates), should be reported for each model fitted. The standardized estimates are easier to interpret and are generally discussed as the percentages of variance explained by a given effect. However, the absolute estimates of the amount of variance due to each source are also important to report as they allow more accurate comparison across samples or in the case of sex-limitation across sexes. It is important to remember that heritability and environmental effect estimates are a property of the sample under analysis; as such, they do not directly generalize to different populations.

Sex limitation

Sex-limitation is the term used to refer to sex differences in the magnitudes and or proportions of the variance accounted for by genetic and environmental effects. There are three types of sex-limitation: scalar, non-scalar, and general non-scalar (Table 3). A path diagram for the opposite sex twins or a table is usually used to summarize the estimates derived from these models.

The scalar sex-limitation is the simplest and most restrictive of the these three models and describes the situation in which the absolute magnitude of the total variance differs between males and females while the proportions of variance accounted for by genetic and environmental effects do not. The name arises from the estimated ratio of male to female variance which is known as a scalar (typically denoted as *k* within the algebra). As the variances are fixed to unity when working with ordinal data, this model can only be tested when working with continuous data.

In non-scalar sex-limitation models the genetic and environmental effects are estimated separately for males and females. For the general non-scalar model an extra

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or A non-identical twin?

genetic or environmental component (m^2) can be modeled for males or females. An alternate way to parameterize this model is to estimate the correlation between genetic or environmental effects in males and females. Conceptually this model describes a situation in which different genes or environmental factors influence males and females.[64] In the standard (or common effects) non-scalar model the variances of males and females are assumed to be equal and the correlation for additive genetic and common environmental influences in the opposite sex pairs are assumed to be ½ and 1 respectively. Conceptually this model describes a situation in which the same genes and environmental effects are hypothesized to influence males and females but the magnitude of these effects are allowed to differ. The difference in fit between these two models can be used to examine whether the same genes or environmental factors are influencing males and females. Note however, that this test can only be conducted if data have been collected from opposite sex twins.

Table 3.3: Variance and covariance by sex and zygosity for sex-limited models as compared to the classical twin (no sex-limitation) model

Model	**I General non-scalar sex-limitation**	**II Non scalar sex-limitation**	**III Scalar sex-limitation***	**IV Classical twin model**
Female variance	$a_f^2+c_f^2+e_f^2$	$a_f^2+c_f^2+e_f^2$	$k*(a^2+c^2+e^2)*k'$	$a^2+c^2+e^2$
Male variance	$a_m^2+c_m^2+e_m^2+m^2$	$a_m^2+c_m^2+e_m^2$	$a^2+c^2+e^2$	$a^2+c^2+e^2$
MZF covariance	$a_f^2+c_f^2+m^2$	$a_f^2+c_f^2$	$k*(a^2+c^2)*k'$	a^2+c^2
MZM covariance	$a_m^2+c_m^2$	$a_m^2+c_m^2$	a^2+c^2	a^2+c^2
DZF covariance	$½\ a_f^2+c_f^2$	$½\ a_f^2+c_f^2$	$k*(½\ a^2+c^2)*k'$	$½\ a^2+c^2$
DZM covariance	$½\ a_m^2+c_m^2+½m^2$	$½\ a_m^2+c_m^2$	$½\ a^2+c^2$	$½\ a^2+c^2$
DZOS (F-M) covariance	$½(a_{f*}a_m)+(c_{f*}c_m)$	$½(a_{f*}a_m)+(c_{f*}c_m)$	$k*(½\ a^2+c^2)*k'$	$½\ a^2+c^2$
Compared to …				
Model number	III	I	I	-
Df	1	3	1	-

* $k=\begin{bmatrix}\frac{F\text{ var}}{M\text{ var}} & 0\\ 0 & \frac{F\text{ var}}{M\text{ var}}\end{bmatrix}$ for same sex female pairs and $k=\begin{bmatrix}\frac{F\text{ var}}{M\text{ var}} & 0\\ 0 & 1\end{bmatrix}$ for opposite sex pairs. An apostrophe (') is used to indicate a transpose.

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[64] Note that differences in both genetic and environmental effects can not be tested simultaneously as this model is not identified (there is no unique solution) when working with twin and sibling data. As such one would usually run this model twice once specifying m^2 as an additive genetic parameter (correlated .5 for the DZ twins) and once specifying m^2 as an common environment parameter (correlated 1 for the DZ twins).

Multivariate Design

Human behaviors, attitudes and decision making processes are seldom characterized as easily measured unidimensional constructs. As a result the majority of the time we are interested in the simultaneous modeling of more than one variable in order to draw conclusions about the extent to which related variables are influenced by the same genetic or environmental effects; the extent to which one trait causes another; and genetic and environmental contributions to development or aging process. Fortunately, twin and family analyses of raw data using structural equation modeling are readily extendable to the multivariate case enabling us to answer such questions.

Genetic analyses of multivariate data draw their explanatory power from the information contained in the variances, cross trait (within individual phenotypic covariance), cross twin (MZ and DZ co-twin) and cross twin-cross trait covariances. These elements are shown schematically in Figure 3. The magnitude of the cross trait covariance elements provides an indication as to whether the traits under analysis share common etiological influences. The relative magnitude of the MZ and DZ cross twin-cross trait covariances provide information regarding whether these causal influences are likely to be genetic or environmental in nature.

		Phenotype1 (P1)	Phenotype2 (P2)	Phenotype1 (P1)	Phenotype2 (P2)
Twin 1	Phenotype1 (P1)	Variance P1 $a^2_{P1}+ c^2_{P1}+ e^2_{P1}$	Cross trait Covariance $r_A a_{P1} a_{P2}+ r_C c_{P1} c_{P2}+ r_E e_{P1} e_{P2}$	Within trait cross twin covariance $(.5/1)a^2_{P1}+c^2_{P1}$	Cross trait cross twin covariance $(.5/1)r_A a_{P1} a_{P2}+ r_C c_{P1} c_{P2}$
	Phenotype2 (P2)	Cross trait Covariance $r_A a_{P1} a_{P2}+ r_C c_{P1} c_{P2}+ r_E e_{P1} e_{P2}$	Variance P2 $a^2_{P2}+ c^2_{P2}+ e^2_{P2}$	Cross trait cross twin covariance $(.5/1)r_A a_{P1} a_{P2}+ r_C c_{P1} c_{P2}$	Within trait cross twin covariance $(.5/1)a^2_{P2}+c^2_{P2}$
Twin 2	Phenotype1 (P1)	Within trait cross twin covariance $(.5/1)a^2_{P1}+c^2_{P1}$	Cross trait cross twin covariance $(.5/1)r_A a_{P1} a_{P2}+ r_C c_{P1} c_{P2}$	Variance P1 $a^2_{P1}+ c^2_{P1}+ e^2_{P1}$	Cross trait Covariance $r_A a_{P1} a_{P2}+ r_C c_{P1} c_{P2}+ r_E e_{P1} e_{P2}$
	Phenotype2 (P2)	Cross trait cross twin covariance $(.5/1)r_A a_{P1} a_{P2}+ r_C c_{P1} c_{P2}$	Within trait cross twin covariance $(.5/1)a^2_{P2}+c^2_{P2}$	Cross trait Covariance $r_A a_{P1} a_{P2}+ r_C c_{P1} c_{P2}+ r_E e_{P1} e_{P2}$	Variance P2 $a^2_{P2}+ c^2_{P2}+ e^2_{P2}$

Figure 3.3 Schematic rep of bivariate variance/covariance matrix (within twin covariances shown in grey, cross twin covariances shown in black)

Generally when beginning multivariate analysis it is customary to begin by fitting an ACE or ADE Cholesky decomposition to the data.[65] This is a simple factor model in which there are as many orthogonal factors, *n* as there are variables. All variables load on the first factor, *n*-1 variables load on the second factor and so on, until the final variable loads on the *n*th factor only. This factor structure is modeled as a lower diagonal matrix (containing estimates of the factor effects known as path coefficients) which is multiplied by its transpose to produce the full factor model. As this factor pattern is repeated for

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[65] Strictly speaking the phenotypic Cholesky (one in which we do not partition the variance into genetic and environmental components) is not a model but a reparameterization of the variance covariance structure to prevent the estimation of non-positive definite matrices. By assuming the fitting an ACE Cholesky to the data we are making assumptions regarding the expected magnitude and source of covariance between relatives based on their zygosity. In this case one might argue the Cholesky becomes a model. However, those in the behavior genetics discipline do not refer to the Cholesky as a model.

each of the three concurrently modeled sources of variation this approach is sometimes referred to as a *triple Cholesky*. The path diagram for a bivariate ACE Cholesky decomposition is given in Figure 4. The Cholesky decomposition is typically described as the saturated model and will have the best fit of any multivariate model. However, by definition it is also the least parsimonious model that can be applied to the data. Thus, it provides an ideal comparison point for other more restrictive multivariate models, providing a base which allows researchers to test the trade off between parsimony and model fit. Generally speaking, the difference in fit between the Cholesky and another nested multivariate model should be compared to a chi-square distribution with the degree of freedom equal to the difference in the number of parameters being estimated.

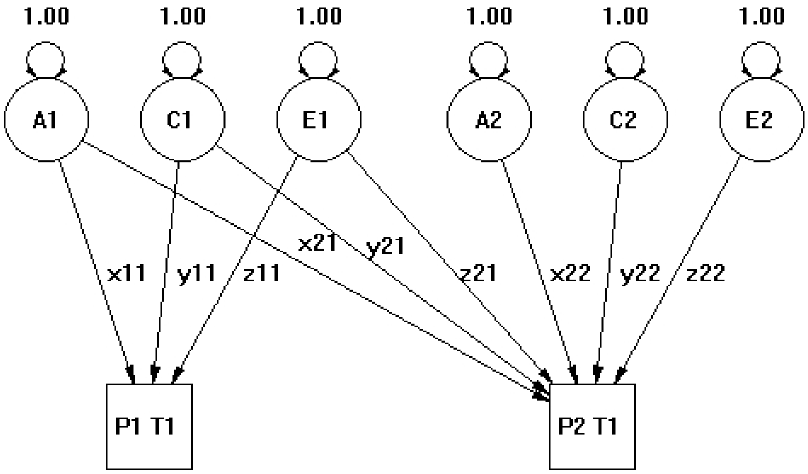

Figure 3.4 Bivariate Cholesky (ACE)

The ordering of variables within a multivariate analysis is important and should be based on theoretical assumptions. Model simplification may proceed in an *a-priori* fashion testing specific multivariate models based on theoretical expectations, i.e. one might hypothesize that the covariation between measures of party affiliation was due to a single latent construct and fit this model (known as a common pathway model) to the data. Alternatively, in the absence of theory model simplification can follow a *post-hoc* exploratory approach in which ‘paths’ or effect estimates are dropped based on their lack of significance. While both methods are valid, an important limitation of the *post-hoc* approach is that changing the order in which variables are entered into the analysis or elements are dropped from the analysis can change the fit and structure of the final 'best fitting' model.

When reporting the results of a multivariate analysis it is expected to provide a correlation matrix giving the cross-twin, cross-trait and cross-twin cross-trait correlations for the different zygosity groups. Following this, one provides the path coefficients for both the full and 'best fitting' reduced model. In reporting multivariate analyses it is typical to report the standardized path coefficients as interpretation of the absolute path coefficients is confounded by potential differences in the variance between variables.[66] The fit statistics for each model fit to the data would be included a table.

Interpretation of the results depends to some extent on the model fitted. Broadly speaking there are three main ways to address the covariation between relatives. To illustrate these methods consider the example of the additive genetic covariation for the situation described in Figures 5a-c (the same approaches also apply to common and unique environmental variance). Firstly (Figure 5a) one may consider the standardized path coefficients and the extent to which covariation between variables is due to each factor. Secondly (Figure 5b) one may discuss the proportions of variance explained and the percent of the phenotypic correlation (r) due to additive genetic effects (A). To do this divide the estimates of the variance[67] due to A by the total variance:

$$\begin{bmatrix} x_{11}^2 & x_{21}^2 \\ x_{21}^2 & x_{22}^2 \end{bmatrix} \div \begin{bmatrix} \text{var v1} & \text{cov v1v2} \\ \text{cov v1v2} & \text{var v2} \end{bmatrix} = \begin{bmatrix} \text{heritability v1} & \text{\% of r due to A} \\ \text{\% of r due to A} & \text{heritability v2} \end{bmatrix}$$

Thirdly (Figure 5c), one may also discuss the genetic correlations, which are the correlations between the genetic effects of the variables. The additive genetic correlation between the first and second variables in Figures 5a-c can be calculated using the following formula: $r_g = \frac{x_{21}x_{11}}{\sqrt{x_{11}^2 * \left(x_{21}^2 + x_{22}^2\right)}}$. Alternatively, using matrix algebra we can

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[66] Standardized path coefficients are calculated by multiplying the absolute path coefficients (modeled as a lower diagonal or triangular matrix) by the standardized deviations of the variables (modeled as a diagonal matrix - with standard deviations on the diagonal and zeros on the off diagonals)

[67] Calculated as X*X'

obtain a genetic correlation matrix by pre- and post- multiplying the estimates of the variance due to A by a matrix containing standard deviations on the diagonals. It is important to keep in mind the proportion of variance that is being explained by A when interpreting the additive genetic correlation, an additive correlation of .95 has very little practical meaning when additive genetic effects are only accounting for 5% of the variation in a trait.[68]

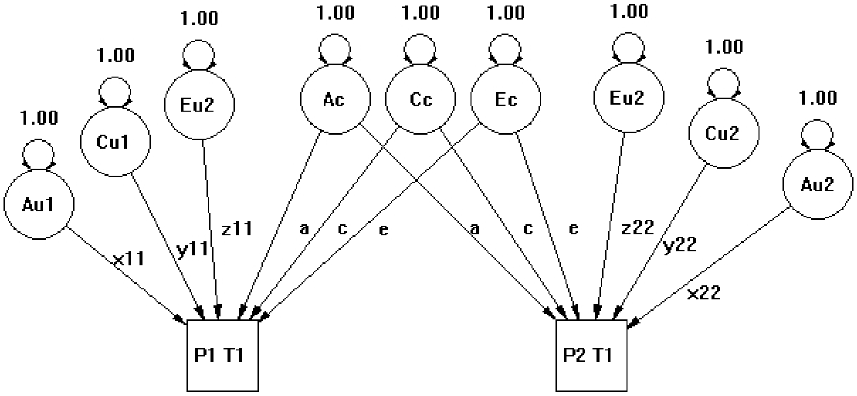

Figure 3.5a - Standardized path coefficients and covariation between variables

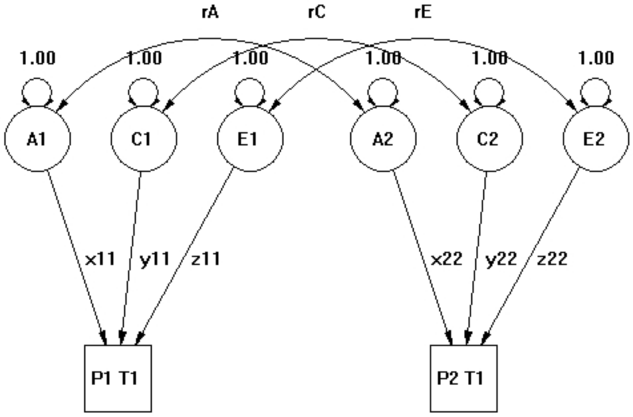

Figure 3.5b Proportions of variance explained and the percent of the phenotypic correlation (r) due to additive genetic effects (A).

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[68] There are other multivariate models not used in these analyses. The most common two are 1) the *common pathway model*: a restrictive model which hypothesizes that the covariation between variables is due to a single underlying "phenotypic" latent variable and 2) the *independent pathway model* which hypothesizes a more flexible factor model in which the variance and covariance between the variables is expected to be due to one (or sometimes two) common factors with the residual variance characterized as variable specific genetic and environmental effects.

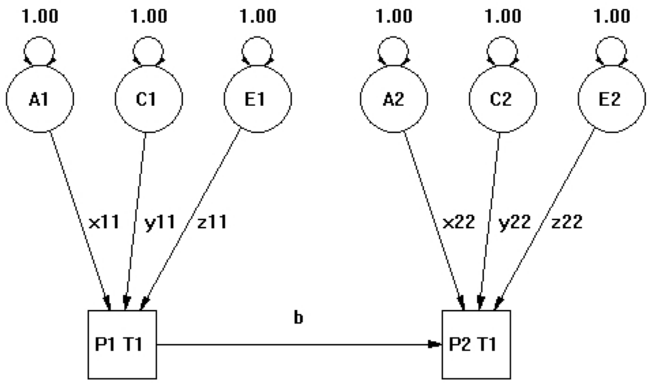

Figure 3.5c - Genetic correlations

Power and Sample Size

Power and sample size are non trivial concerns in the modeling of twin and family data particularly when using ordinal data. Generally speaking, in the classical twin analysis there is less power to detect significant common environmental influences as the numbers of MZ and DZ twins are usually similar. However, the power to discriminate A from C is maximized when the ratio of MZ:DZ is 1:4 (Nance and Neale 1989). One way to increase this ratio is to over sample DZ pairs. However, an alternative and arguably more valuable strategy is to collect data from both the twins and any non-twin siblings.

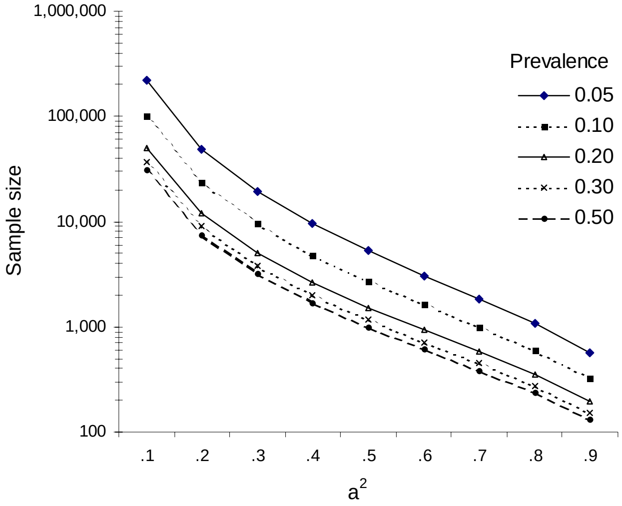

Figure 3.6 -illustration of the effects of prevalence and true heritability on the power to reject the CE model when the true model is an AE model at the .05 level of significance and 80% power. The required sample size is plotted on a logarithmic scale. Equal numbers of MZ and DZ pairs are assumed.

A limitation of the use of ordinal data is loss of power associated with categorical compared to continuous measurement (Neale et al. 1994). As shown in Figure 6, the number of twin pairs required to detect the presence of additive genetic effect in traits with low prevalence can be prohibitive. A similar problem is observed when attempting to detect common environmental effects (Figure 7). The number of pairs required for a continuous normally distributed trait is shown for comparison. Addition of sibling data goes some way to ameliorating this problem (Posthuma and Boomsma 2000). Power increases if the data can be modeled as more than two categories, but not if the addition of an extra category involves subdividing the smaller binary category (Neale et al. 1994).

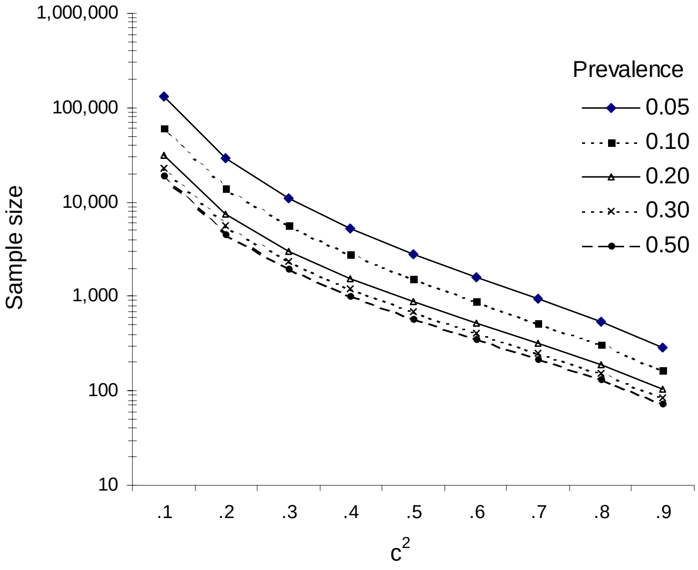

Figure 3.7 - Illustration of the effects of prevalence and true common environmental variance on the power to reject the additive genetic and unique environmental (AE) model when the true model is a common and unique environmental (CE) model at the .05 level of significance and 80% power. Sample size is plotted on a logarithmic scale. Equal numbers of MZ and DZ pairs are assumed.

A Practical Exercise – Attitudes on the Death Penalty

Since the 1976 US Supreme Court ruling that the death penalty was not inherently unconstitutional numerous examinations of public support for the death penalty have ensued in the social sciences. While some studies examining the effect gender, race, and psychological constructs such as authoritarianism and conservatism exist outside of the social sciences (Gelles and Straus 1975; Hessing et al. 2003; Gunn 2004), the vast majority of social science research focuses on environmental predictors such as crime rate, education, public access to information on DNA, public and electoral salience, death penalty as a defining credential for conservatism, income, party affiliation, family environment, exposure to violence and religious beliefs among others (Bohm 1987; Bohm et al. 1991; Grasmick and Bursik 1993; Mooney and Lee 1999; Norrnader 2000; Gross and Ellsworth 2001). A majority of these studies are able to explain 10 to 30% of the variance, the later being quite significant for social science research. However these environmental variables do not account for all of the variance. Are scholars missing important environmental stimuli in their models, or are they looking in the wrong place? Are attitudes on the Death penalty determined by factors social sciences are not measuring, such as genes?

Using biometrical genetic theory, such as a classical twin method (CTD), we can begin to answer these questions. Initially we would need to conduct a survey or have access to an already completed survey of twins pairs, including age, sex, measure on zygosity, and a measure of the phenotype (attitude on the death penalty in this case). Fortunately, Lindon Eaves (Virginia Institute for Psychiatric and Behavioral Genetics) and Nick Martin (Genetic Epidemiology, Queensland Institute of Medical Research) have conducted these studies in the 1980's during a period on which the Death Penalty issue was highly salient. The following is a description of the samples used which provides a basic example of a suitable description for future research:

> **Sample**
> "Data were collected in the late 1980's by the Virginia 30,000 Health and Life-Style Survey for Twins recruited from the Virginia population based twin registry and the American Association of Retired Persons (Eaves et al. 1999). The sample consists of 14,763 twin men and women aged 18-88 years. The Health and Lifestyle Questionnaire (HLQ) contained one item measuring attitudes on the Death Penalty (Martin et al., 1987; Eaves et al., 1989; Truett et al., 1992). Completed questionnaires were received from 69.8% of twins invited to participate.
>
> **Zygosity**
> Zygosity was determined by two self report items. This method has been shown to provide probably better than 95% agreement with blood typing (Martin and Martin, 1975; Eaves *et al.,* 1989).

> **Measure**
> Opinion in the Death Penalty was assessed utilizing a modified version of the Wilson-Patterson (1968) Conservatism Scale.[69] Respondents indicated if they agreed (1), disagreed (3), or were uncertain (2) about the Death Penalty (Posner et al., 1996). Traditional public opinion correlates including age, education, social class, religion and church attendance (Campbell et al., 1960; Popkin, 1991) were also assessed. Date of birth, originally a continuous variable, was used to divide the respondents into seven age groups (Sapiro et al., 2006) routinely used for studies in the political science literature (18-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75+)."

Preliminary Analyses and Assumptions Testing

After the sample and measures have been determined, typically certain preliminary analyses need to be performed prior to utilizing the CTD.

Thresholds: Since attitude towards the Death Penalty is an ordinal phenotypic trait, a threshold model is required for the analyses. Threshold starting values are calculated from the frequencies for this trait. There are several methods to determine starting values, however simpler is often better. The number of starting values is the number of response options – 1. Using the excel spreadsheet NORMSINV() function as illustrated below to calculate z scores from frequency counts (0=No, 1= I don't know and 2 =yes), the two starting points of -1.5 and .98 are derived.

Calculation of z scores from frequency counts using Excel

Category	Total	Cumulative Total	Probability	z score	z score diff.
0	513	513	0.0656	**-1.508**	
1	1830	2343	0.299	-0.524	**0.984**
2	5468	7811	1	-	-

Thresholds were tested for equality across different zygosity groups to eliminate any biases in the variance decomposition, and to verify randomness of sampling. Each of the five zygosity groups (MZ Male, MZ Female, DZ Male, DZ Female, and DZ opposite sex) has two thresholds (once for each twin 1 and twin 2, two variances and one covariance).

---

[69] The Wilson–Patterson (W–P) Attitude Inventory is administered by presenting subjects with a short stimulus phrase such as abortion or gay rights and eliciting a simple agree, disagree, or uncertain response. The broadest version of the W–P inventory includes 50 items, but most studies typically utilize reduced sets of W–P items to suit the particular study.

Several thresholds models were examined, including 1) equating thresholds for twin 1 and twin 2 within same sex pairs to test for birth order effects, 2) equate the thresholds across same sex MZ twins and equate the thresholds across same sex DZ twins to test for homogeneity of thresholds between MZ and DZ twins, 3) equate the thresholds across all female twins and equate the thresholds across all male twins, testing homogeneity of thresholds between all MZ and DZ twins within all female twins and within all male twins and 4) equated all thresholds, testing for differences between male and female thresholds. When examining attitudes on the death penalty there were no significant differences for birth order or between types of twins, but the thresholds were significantly different for males and females. As such, these sex differences in the thresholds were retained for future analyses. Thresholds were corrected for the linear effects of age.

Covariances: Threshold testing established regularity and randomness of sampling, however, the focus of twin studies is on the pattern of covariance across different zygosity groups. The correlations for all five zygosity groups are displayed in Table 4.

Table 4: Twin Correlations for Attitudes on the Death Penalty

	MZF	DZF	MZM	DZM	DZOS
Death Penalty	.56	.38	.54	.43	.29
N Pairs[a]	2029	1273	826	610	1397

Note: (a) Correlations were estimated for full information maximum likelihood observations on incomplete pairs. Due to missingness cases range as follows: MZF(1967-2029), DZF (1223-1273) ,MZM (808-826), DZM (593-610), DZOS (1359-1397).

If attitudes on the Death Penalty are genetically influenced, the correlation between MZ twins should be significantly greater than the correlation between DZ twins. However, genetic variation between males and females may not necessarily be the same (sex limitation). Examining Table 4 notice that MZ correlations are greater than DZ's and the DZ twin correlation is at least half that of the MZ correlation, supporting the use of ACE model versus and ADE model.

Univariate Analyses

While significant twin correlations establish familial aggregation for attitudes on the Death Penalty, they do not distinguish between the sources of which this similarity occurs, whether socialization or genetic. As noted earlier the most common method for determining the relative importance and source of variance is the Classical Twin Design, which explores the twin relationship by the use of structural equation modeling that decomposes variance into an additive genetic component (A), a common environmental (C) and a unique environmental component (E).[70] Typically, if the MZ correlation is greater than twice the DZ correlation, an ADE instead of and ACE model is fitted to the raw data (this was not the case for attitudes on the Death Penalty). The vast majority of behavior geneticists utilize the free software program Mx 1.60 developed by Mike Neal (Neale et al. 2003) for genetic model fitting. Ideally the author would describe this model as follows:

> Correlations between the latent additive genetic factors are 1 for monozygotic twins (MZ) and .5 for dizygotic twins (DZ), including opposite sex pairs (OS). Correlations between the latent common environment factors are 1 in both MZ and DZ twin pairs.

Determination of which twins to use is also described at this time, such as the inclusion of opposite sex DZ twin pairs, siblings, or parental data.

Sub-models and Model Fitting

Once the methods and model is described, the author includes as description of the reduced models and the type of model fitting used to compare the reduced models to the saturated model. In a classical twin design using Mx, nested models are compared using chi-square difference test assessed by the difference in log likelihood between the reduced and full model.

The following reduced models were examined 1) equating the thresholds between like sex MZ and DZ twins (Equal environments assumption), 2) equating the thresholds for all twins male and female MZ and DZ twins 3) equating the variance components

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[70] If desirable, the author may replace the (C) component with a nonadditive (dominant) genetic component (D). C and D are negatively confounded so that they cannot be estimated concurrently in a study of MZ and DZ twins reared together. This does not imply that C and D cannot both contribute to the phenotypic variance of a trait, rather they cannot be estimated simultaneously with data from twins.

between males and females (equating the separate path coefficients for males and females tests whether sex specific differences in the magnitude of the variance components provide a better model fit than without sex differences), 4) removing the common environment component, 5) removing the additive genetic component 6) removing both the common environment and additive genetic components.

In the Depth Penalty phenotype, our hypothesis is that genetic factors may also account for the variance regarding attitudes on the death penalty. Thus, we first determine the best fitting full SEM model and then compare it to reduced models removing the C component, and then the C and E components to determine if an AE model, CE model or full model is a better fitting model. The null hypothesis in the social science literature is a CE model. The significance of the variance components were assessed by testing whether dropping A or C reduced model fit.

Results

Once the model is described, the results are presented (Table 5). Equating thresholds for MZ and DZ pairs was better fitting than the initial model, thus providing no evidence there was a violation of equal environments assumption (EEA); equating thresholds for males and females (testing for the need to correct for sex) and equating the variance components for males and females to determine if sex difference exist in the estimates also proved a better fit. However any reduction of the model by removing the entire additive genetic component (A) or common environment component (C), or both for all items worsened model fit. The best fitting model was one in which all three variance components were present and one which the thresholds and variance components for males and females were equated.

Table 3.5 Standardized Variance Components (95% CI) Sex Limitation Model Fitting for Death Penalty: Thresholds Corrected For Age

	Parameter Estimates									
	Females			Males						
Model	a^2	c^2	e^2	a^2	c^2	e^2	-2LL	ΔX^2	Δdf	p-value (comparison model)
ACE	.34 (.15-.52)	.23 (.07-.34)	.44 (.39-.49)	.36 (0.-59)	.18 (.02-.57)	.46 (.36-.59)	18868.929			-
EEA Test	.34 (.15-.52)	.23 (.07-.34)	.44 (.39-.49)	.36 (0.-59)	.18 (.02-.57)	.46 (.36-.59)	18872.53	3.60	4	.46 (ACE)
EQ TH	.32 (.15-.49)	.27 (.09-.37)	.41 (.36-.46)	.39 (.02-.56)	.11 (0-.52)	.50 (.40-.60)	19073.59	201.06	6	<.001 (ACE)
ACE (M=F)	**.35 (.22-.48)**	**.21 (.10-.31)**	**.44 (.40.-48)**	**.35 (.22-.48)**	**.21 (.10-.31)**	**.44 (.40.-48)**	**18872.82**	**0.29**	**3**	**.96 (ACE)**
AE	.58 (.36-.67)	-	.42 (.33-.64)	.58 (.36-.67)	-	.42 (.33-.64)	18887.15	14.62	2	<.001 (ACE)
CE	-	.49 (.42-.66)	.51 (.44-.58)	-	.49 (.42-.66)	.51 (.44-.58)	21345.89	2473.36	32	<.001 (ACE)
E	-	-	1	-	-	1	22528.23	3655.70	4	<.001 (ACE)

Practical Exercise Conclusion

While a majority of the variance (.65) is accounted for by the combination of common and unique environmental factors, a significant portion of the variance (.35) is genetic. Furthermore, genes accounts for more of the variance than socialization, but as much as unique environment. Thus, the traditional model used by social scientists (the assumption of a CE model) is not supported by the data used here.

While this exercise many not employ the most advanced methodological and analytical techniques available that one may wish to apply (multivariate, extended family , non-twin siblings etc), the concepts and framework presented offer a usable beginning to explore the use of biometrical genetic theory for the analyses of political opinion.

Conclusion and Discussion

The study of human behavior, whether in a sociological frame, biological frame, psychological frame, or a political science frame remains the same. We all attempt to show in some form or another why people do what they do. However the tools, approach, direction and even locus of control remain vastly different in each discipline. While this separation of research paradigms is economical in that methodologies are standardized and expectations to publish are clear, the findings, while appearing clear within the given frame, are often unrealistic outside of academia or even outside the discipline.

Long has the cliché of the “ivory tower” been used to discount academic findings, and those criticisms are not without merit. How is it that until now, in a PhD thesis, the methodology used to examine the genetics of our species remained largely unexplored in the analyses of the variance of political attitudes? How is it that political science has blatantly ignored the groundbreaking findings in genetics and done so for over four decades until Alford et al.’s (2005) piece?

Genes do affect our behaviors and political attitudes. The question is whether political scientists Will choose to stand on the sidelines and let geneticists explain individual political preferences, or choose to adopt and adapt behavior genetics methods into political study to provide a more complete picture. Social scientist we make several incorrect implicit assumptions; there are two specifically that cannot be ignored:

1. Political preferences and behaviors are either socially influenced or matters of personal experience consciously and rational driven. This is untrue; while known for some time in the hard sciences since the 1970's, Alford et al exposed these revelations to the political science community.
2. People are genetically the same and genes are given. While not explicitly addressed in the literature, political science research treats all persons as genetically equal. We do not control for genes in any given study. However, people are not the same; this fact is the mainstay of an entire discipline (behavior genetics). Given the tools to examine individual genetic differences it is time to use them, as current poli-sci techniques are now dated.

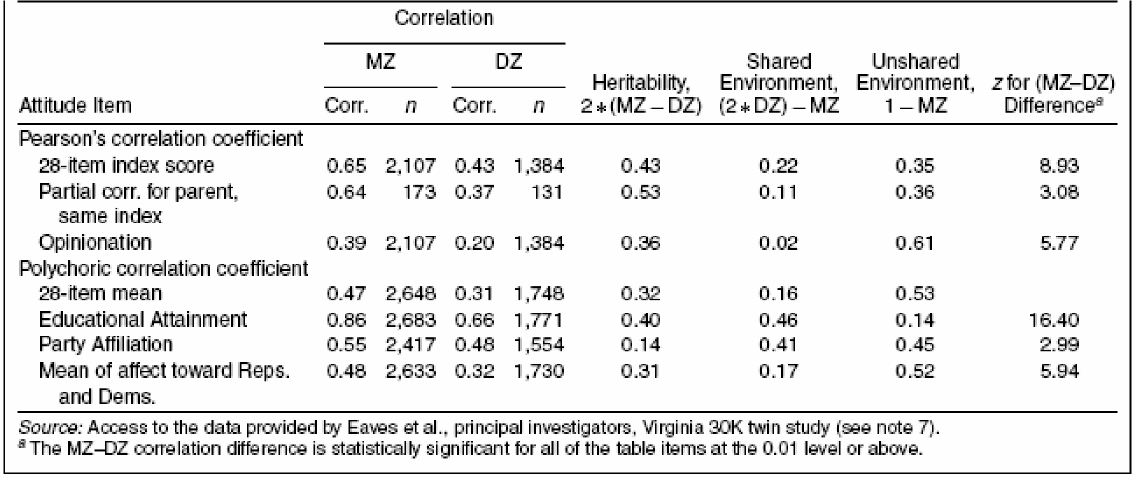
Utilizing the methods provided in this chapter gives us the means to statistically remove genetic influences or common environmental influences in any given trait. As a matter of practical application, it gives us a means to test our main theories of political preferences for each trait specifically. If we rule out common environment, we rule out familial socialization as a casual influence for that trait. If we show unique environment accounts for little of the variance, we show that rational choice, as traditionally defined, is not relevant for that specific trait. If we find that genes account for the majority of the variance, we show that neither of the main theories used to account for the specific political behavior is strongly applicable. Most importantly, by incorporating genes we can explain more of the variance in political behaviors. By using a method outside of our normal discipline and utilizing a third source of variance (genes), we in effect give ourselves a means to test our traditional theories for each trait under analysis and test whether the environmental variables we are using are in effect explaining all the variance that can be explained using only environmental items. If anything we can stop wasting time in useless paradigm debates (rational choice versus behavioralism etc), and begin to actually explain behavior with a proven theory on a per trait basis.

While this chapter will not revolutionize the discipline, it may very well be the makings of an important piece in which political scientists can draw upon to develop a more robust research agenda and more sound methodological approach to study individual political behavior.

Chapter 4 –The Genetics of Political Attitudes[71]

Currently there exists only one study within the political science literature that examines the genetic components of political attitudes. Alford, Funk and Hibbing's (2005) article, "Are Political Orientations Genetically Transmitted?" reported that heritability can explain up to 50 percent of the variance in political attitudes. Using an older and less robust classical twin method they provided the additive genetic component to all 28 political items examined (see Table 1 and Table 2).[72] While the results were not incorrect for the method of analysis utilized in their study, the method itself was dated in comparison to the twin techniques used today in the behavior genetics discipline. Alford et al. (2005) did not test reduced models to determine whether removing either the additive genetic or common environmental components provided a better fit to the data. Furthermore, the analyses did not examine the impact age and sex have on the model results, include the opposite sex (OS) twin pairs, provide 95% confidence intervals, or address the main critique of the twin method, the equal environment assumption (EEA).

Table 4.1 Genetic and Environmental Influences on Political Attitudes: Summary Index and Additional non-Wilson-Patterson Items (Alford et al. 2005)



	Correlation							
	MZ		DZ					
Attitude Item	Corr.	*n*	Corr.	*n*	Heritability, 2∗(MZ – DZ)	Shared Environment, (2∗DZ) – MZ	Unshared Environment, 1 – MZ	*z* for (MZ–DZ) Difference[a]
Pearson's correlation coefficient								
28-item index score	0.65	2,107	0.43	1,384	0.43	0.22	0.35	8.93
Partial corr. for parent, same index	0.64	173	0.37	131	0.53	0.11	0.36	3.08
Opinionation	0.39	2,107	0.20	1,384	0.36	0.02	0.61	5.77
Polychoric correlation coefficient								
28-item mean	0.47	2,648	0.31	1,748	0.32	0.16	0.53	
Educational Attainment	0.86	2,683	0.66	1,771	0.40	0.46	0.14	16.40
Party Affiliation	0.55	2,417	0.48	1,554	0.14	0.41	0.45	2.99
Mean of affect toward Reps. and Dems.	0.48	2,633	0.32	1,730	0.31	0.17	0.52	5.94

Source: Access to the data provided by Eaves et al., principal investigators, Virginia 30K twin study (see note 7).

[a] The MZ–DZ correlation difference is statistically significant for all of the table items at the 0.01 level or above.

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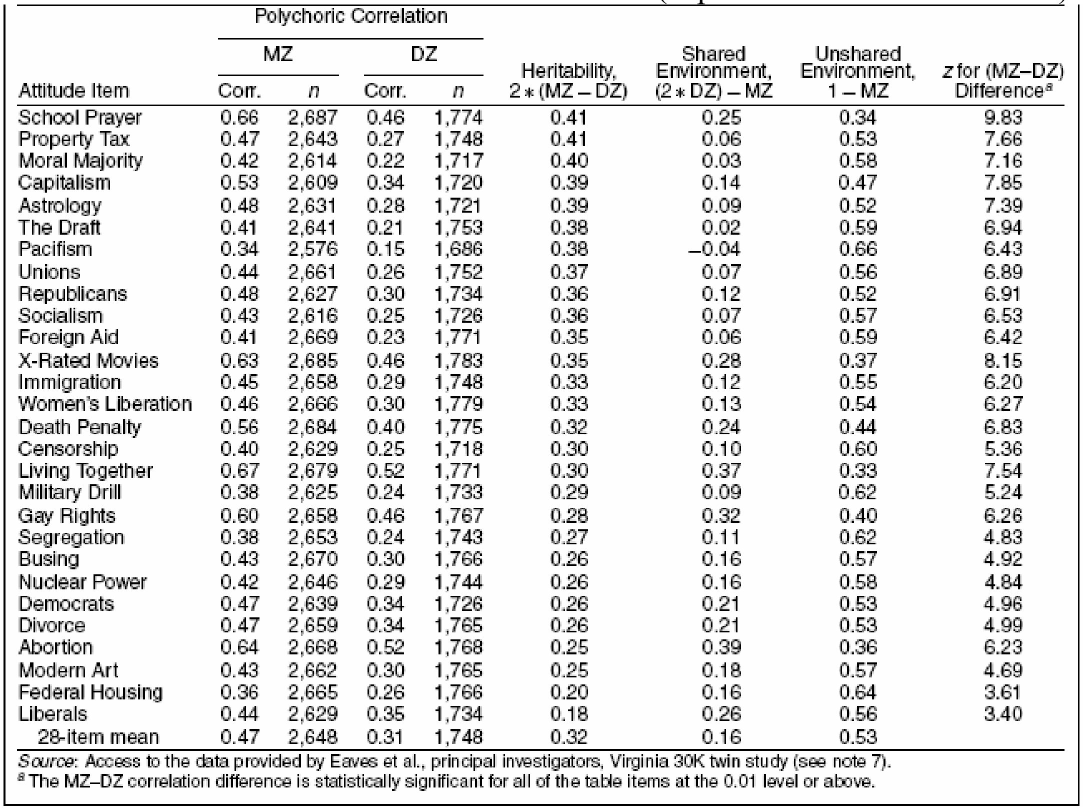
[71] Portions of this chapter are under review as a manuscript in Hatemi et al (2007).

[72] Alford et al (2005) used polychoric correlation analysis and did not test reduced models and there fore did not utilize a threshold model, as is the normally accepted practice when examining ordinal data.

Table 4.2 Genetic and Environmental Influences on Political Attitudes: The 28 Individual Wilson-Patterson Items (copied from Alford et al. 2005)



	Polychoric Correlation							
	MZ		DZ					
Attitude Item	Corr.	*n*	Corr.	*n*	Heritability, 2∗(MZ − DZ)	Shared Environment, (2∗DZ) − MZ	Unshared Environment, 1 − MZ	*z* for (MZ–DZ) Difference[a]
School Prayer	0.66	2,687	0.46	1,774	0.41	0.25	0.34	9.83
Property Tax	0.47	2,643	0.27	1,748	0.41	0.06	0.53	7.66
Moral Majority	0.42	2,614	0.22	1,717	0.40	0.03	0.58	7.16
Capitalism	0.53	2,609	0.34	1,720	0.39	0.14	0.47	7.85
Astrology	0.48	2,631	0.28	1,721	0.39	0.09	0.52	7.39
The Draft	0.41	2,641	0.21	1,753	0.38	0.02	0.59	6.94
Pacifism	0.34	2,576	0.15	1,686	0.38	−0.04	0.66	6.43
Unions	0.44	2,661	0.26	1,752	0.37	0.07	0.56	6.89
Republicans	0.48	2,627	0.30	1,734	0.36	0.12	0.52	6.91
Socialism	0.43	2,616	0.25	1,726	0.36	0.07	0.57	6.53
Foreign Aid	0.41	2,669	0.23	1,771	0.35	0.06	0.59	6.42
X-Rated Movies	0.63	2,685	0.46	1,783	0.35	0.28	0.37	8.15
Immigration	0.45	2,658	0.29	1,748	0.33	0.12	0.55	6.20
Women's Liberation	0.46	2,666	0.30	1,779	0.33	0.13	0.54	6.27
Death Penalty	0.56	2,684	0.40	1,775	0.32	0.24	0.44	6.83
Censorship	0.40	2,629	0.25	1,718	0.30	0.10	0.60	5.36
Living Together	0.67	2,679	0.52	1,771	0.30	0.37	0.33	7.54
Military Drill	0.38	2,625	0.24	1,733	0.29	0.09	0.62	5.24
Gay Rights	0.60	2,658	0.46	1,767	0.28	0.32	0.40	6.26
Segregation	0.38	2,653	0.24	1,743	0.27	0.11	0.62	4.83
Busing	0.43	2,670	0.30	1,766	0.26	0.16	0.57	4.92
Nuclear Power	0.42	2,646	0.29	1,744	0.26	0.16	0.58	4.84
Democrats	0.47	2,639	0.34	1,726	0.26	0.21	0.53	4.96
Divorce	0.47	2,659	0.34	1,765	0.26	0.21	0.53	4.99
Abortion	0.64	2,668	0.52	1,768	0.25	0.39	0.36	6.23
Modern Art	0.43	2,662	0.30	1,765	0.25	0.18	0.57	4.69
Federal Housing	0.36	2,665	0.26	1,766	0.20	0.16	0.64	3.61
Liberals	0.44	2,629	0.35	1,734	0.18	0.26	0.56	3.40
28-item mean	0.47	2,648	0.31	1,748	0.32	0.16	0.53	

Source: Access to the data provided by Eaves et al., principal investigators, Virginia 30K twin study (see note 7).

[a] The MZ–DZ correlation difference is statistically significant for all of the table items at the 0.01 level or above.

However there are numerous studies which exist outside of political science finding that social attitudes have a genetic component (Martin et al., 1986; Martin, 1987; Eaves et al., 1989; Truett et al., 1992; Posner et al., 1996; Eaves et al., 1998; Eaves et al., 1999; Olson et al., 2001; Bouchard et al., 2003). These studies in the Behavior Genetics discipline pioneered the methodology used in genetic study. Thus, it is appropriate to replicate and validate the Alford et al. (2005) findings using the most robust methods developed in the behavior genetics discipline. Examining additional data from Australia also provides the opportunity for converging evidence. While the aforementioned studies in the behavior genetics discipline have reviewed these data, they have not done so consistent with the literature in our own disciple or placed the findings in a political science frame. Furthermore, the findings remain largely unknown to those in the social sciences due to the lack of frame and exposure. The behavior genetic literature typically reports the genetic components of certain attitudes, but offer little in the way of interpretation or hypothesis testing.

This analysis will also test of the main social science critique of the twin method, the equal environment assumption (EEA). Although the social science EEA critiques have been repeatedly found to be without merit in most examinations of behavior and personality, the potential violation of the EEA has not been tested in the literature for political attitudes specifically.

Until recently, it was widely assumed that political attitudes were largely, if not entirely, fashioned by familial socialization, including parenting, education and socioeconomic status. As Altemeyer (1988: 63) put it, we "get our opinions where we get our corn pone—at home." As this view can now be empirically tested, it is imperative to update the initial Alford et al. (2005) findings using the most modern methods and provide converging evidence whenever possible.

Hypotheses

While I expect no stunning revelations from the re-analyses of the Alford et al. (2005) data, it is well known that not all phenotypes have a genetic or a common environmental component. The first step in most analyses of twins is to examine the polychoric correlations of the MZ and DZ twin pairs. Of primary interest is the expectation of AE, CE or E models. Traditional social attitudes and behaviors tend to have wide confidence intervals. A quick and dirty or "eyeball" method to rule out genetic effects is look for very small correlation differences between MZ and DZ twins. Although Alford et al.'s initial analyses did not use opposite sex twin pairs or separate twins by sex, using their initial analyses, one item in particular ("Party Affiliation"), has only a .07 correlation difference between MZ and DZ pairs. The remaining items are not nearly as suspect. Therefore, I expect to find that the additive genetic component of Party Affiliation is likely non-existent when tested for model fit. "Eyeballing" to remove common environmental (C) influence is not as easy, but I expect those items with large correlation differences between MZ and DZ twins to have model fits that call for the removal of the C component. When looking at the initial correlations we have to keep in mind that the Alford et al. analyses (Tables 1 and 2) did not include opposite sex pairs, or separate males and females, thus our initial thoughts may be misleading.[73]

In addition I expect to find that many items have significant differences between the male and female variance components. While these differences will be explored in detail in chapter 7, my initial expectation is differences do exist! Furthermore, I expect that no violation of the equal environments assumption will be found. It is highly unlikely that parents would socialize identical twins in an identical manner and fraternal twins in a different manner (or vice versa) when it comes to social and political values. One's twinness (whether identical-MZ or fraternal-DZ), should make little difference in their phenotypical socialization.

Therefore, this chapter re-examines Alford Funk and Hibbing's (2005) findings, and re-analyses the data used (Virginia 30K study)[74] as well as introduce previously unanalyzed data - opposite sex twin pairs and data provided by the Australian Twins registry on some of the same questions. While several examinations in the behavior genetics literature (Eaves et al. 1998; 1999) have used the same social and political variables, these variables were mainly examined as an index score for conservatism and not individually and left out the OS pairs. The only examination which looked at the items individually is found in the political science literature but they did not model fit, provide confidence intervals, examine opposite sex pairs, test for male-female differences, or empirically consider the equal environments assumption. Hence this chapter is designed to provide both replication and converging evidence of the heritability of political attitudes using the most precise methodology available, while placing the findings in a social science frame.

Methods

US Sample

Data were collected in the late 1980's by the Virginia 30,000 Health and Life-Style Survey for Twins recruited from the Virginia population based twin registry and the

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[73] A brief examination of Tables 1 and 2 also can all but rule out dominance effects. The only potential candidate is pacifism, as the DZ correlation is .15 and MZ correlation is just over twice that at .34.

[74] See Eaves et al (1999) for more information on the sample.

American Association of Retired Persons (Eaves et al. 1999). The sample consists of 14,763 twin men and women aged 18-88 years. The Health and Lifestyle Questionnaire (HLQ) contained items about health, alcohol and tobacco consumption, smoking, life-events, personality, social support, psychiatric symptoms, disease history, as well as partisan support, social attitudes and a variety of socio-demographic variables, including a 28 item modified version of the Wilson-Patterson Social Attitudes Inventory (Martin et al., 1987; Eaves et al., 1989; Truett et al., 1992). The twins were recruited from two sources. Public birth records in Virginia were matched with other public records for twins born between 1915 and 1971. Questionnaires were mailed to twins who had returned at least one questionnaire in earlier surveys and 5287 families completed the survey. The additional 9476 twins responded to an advertisement published in the newsletter of the American Association of Retired Persons (AARP) (Truett et al. 1994). Thus the sample is divided in to two groups, the "Virginia cohort" and the "AARP cohort."[75] Twins were asked to provide the names and addresses of their spouses, siblings, parents, and children for a follow-up study of relatives. Second and third mailings were sent to nonrespondents and a telephone follow-up was conducted in an attempt to complete twin pairs where only one twin had responded. Completed questionnaires were received from 69.8% of twins invited to participate.

The demographics of the sample are as follows: 59.7% female; 50% under 50 years in age; 74% married or living with someone and 13% widowed, separated, or divorced; 88% having a high school diploma or better; and 65.8% Protestant, 15.5% Catholic, 3.9% Jewish, and 10.3% other religion. Previous studies have found that these results are representative of the population in general with regard to education, socioeconomic status and social behaviors (Truett et al. 1994).[76]

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[75] The sample is almost exclusively Caucasian (99.8%) because funding was originally available to study Caucasians (Truett et al 1992; Eaves et al 1999).

[76] According to Truett et al (1994): "…compared to the U.S. population, where whites are 51.2% female and 90% Catholic or Protestant, 3% Jewish and 7% "other" or "*'no*" religion. The median family income in this study is $34,000, compared to the estimated $30,260 average family income for Caucasians in 1985 (New York Public Library 1989)."

Australian Sample

Data were collected in the course of mailed surveys of two large cohorts of adult Australian twins born 1902-1972 conducted in 1988-90. The first was a follow-up survey of twins enrolled on the volunteer Australian Twin Registry born 1893-1964 originally surveyed from 1980-82 (Martin et al., 1986). The sample consisted of 7616 twin men and women aged 18-88 years. A total of 3808 twin pairs responded to that study in which, *inter alia,* twins were asked to complete a Health and Lifestyles questionnaire (Martin et al., 1987; Eaves et al., 1989; Truett et al., 1992). In 1988-90 a follow-up survey of this cohort was conducted by attempting to mail all individuals who had responded to the first survey. This Health and Lifestyle Questionnaire (HLQ) contained items on voting preference, social attitudes and a variety of socio-demographic variables. After mail and telephone follow-ups, questionnaires were returned by 6327 individuals (83.1%) including 2995 complete pairs (78.7%). Excluding people who had died or were too sick to participate (217 individuals) or with whom contact could no longer be made (270 individuals), return rates for those who received and were able to return the 1988 questionnaire were 88.8% individually and 85.6% pairwise (Baker et al., 1996).

The second study, 1988-90, attempted to survey by mailed questionnaire all twins enrolled on the Australian Twin Registry who had turned 18 since the first survey (i.e. birth years 1964-1972). The HLQ, which was similar to that sent to the older cohort, was mailed to 4269 pairs. Most of these twins had been recruited while attending primary school some ten years earlier, so despite extensive follow-up the investigators were unable to re-establish contact with (exactly) 1000 pairs. Those who failed to return a questionnaire were contacted by telephone up to five times at which point they were asked to complete an abbreviated telephone interview to obtain basic demographic information. Both members of 2294 pairs (70% of contactable pairs) completed a questionnaire or abbreviated phone interview, plus a further 474 single twins, making an individual cooperation rate of 84% of those with whom contact was established. Combining both AUS studies 11,376 questionnaire responses (5289 complete pairs) in which the voting preference item was asked were received, and of these 9,053 individuals responded. The same items were used in both HLQ surveys. However, a limited number of respondents in the AL2 cohort received abbreviated telephone questionnaires where certain socio-political questions were not included.

Comparisons with the Australian Bureau of Statistics provide evidence that these groups are representative of the population in general with regard to education, socioeconomic status and social behaviors, as reported in earlier studies (Jardine and Martin, 1984; Kendler et al., 1995; Baker et al., 1996; Heath et al., 1997; Whitfield et al., 2005).

Zygosity for Both Samples

Zygosity was determined by two self report items for both the US and AUS sample. This method has been shown to provide probably better than 95% agreement with blood typing (Martin and Martin, 1975; Eaves *et al.,* 1989). This method has been validated against blood typing in a number of studies (Martin and Martin 1975; Kasriel and Eaves 1976).[77]

Demographic comparisons of the US and AUS sample

The total US sample was 59.7 % female and 40.3% male; the age range was 18-94 (mean = 49, standard deviation = 17.5). Similar to that of the US sample, the total Australian sample was 61.4% female and 38.6% male, and the age range was 18-88 (mean = 34, standard deviation = 13.8), making them well suited for comparison.[78]

Measures

Political attitudes were assessed utilizing a modified version of the Wilson-Patterson (1968) Conservatism Scale, which includes contemporary social issues of the time.[79] Respondents indicated if they agreed (1), disagreed (3), or were uncertain (2) about their attitudes towards these different issues (Posner et al., 1996).

A number of other sociodemographic variables and political attitudes were analyzed. Traditional sociodemographic voting correlates including age, education, social class, religion and church attendance (Campbell et al., 1960; Popkin, 1991) were assessed. Date

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[77] In addition, blood group and microsatellite marker information has been used to supplement respondent self reports in previous studies using the Australian sample (Whitfield et al., 2004).

[78] These samples are described in detail in Lake et al. (2000) Truett et al (1992) and Eaves et al (1999).

[79] The Wilson–Patterson (W–P) Attitude Inventory is administered by presenting subjects with a short stimulus phrase such as abortion or gay rights and eliciting a simple “agree”, “disagree”, or “uncertain” response. The broadest version of the W–P inventory includes 50 items, but most studies typically utilize reduced sets of W–P items to suit the particular study.

of birth, originally a continuous variable, was used to divide the respondents into seven age groups (Sapiro et al., 2006) routinely used for vote choice studies in the political science literature (18-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75+).

Individual Attitude Analyses

While significant twin correlations establish a potential familial relationship, they cannot distinguish between genetic and environmental effects, or separate between common or unique environmental effects. The original analyses utilized by Alford et al. (2005) relied on polychoric correlation as initially described by Jinks and Fulker (1976). The method is described as follows:

> Heritability is typically estimated by subtracting the correlation for DZ pairs from the correlation for MZ pairs and then doubling the resulting difference. At one extreme, if the correlations are the same for MZ and DZ pairs, suggesting that genetic similarity plays no role in similarity for that particular trait, then the result will be an estimate of heritability of zero. At the other extreme, a purely genetic additive trait should produce a correlation of .5 for DZ pairs and 1.0 for MZ pairs, resulting in an estimate of heritability of 1.0 (1.0−.5=.5 and 2*.5=1.0). In a similar way, we can estimate the influence of shared environment, as opposed to shared genetic material, by doubling the correlation for DZ pairs and then subtracting the correlation for MZ pairs. Again, a purely genetic additive trait should produce a correlation of .5 for DZ pairs and 1.0 for MZ pairs, resulting in an estimate of the impact of shared environment of zero (2 * .5=1.0, and 1.0−1.0=0). At the other extreme, if the correlations are the same for MZ and DZ pairs, suggesting that genetic similarity plays no role in similarity for that particular trait, then the result will be an estimate of the impact of shared environment that is equal to the MZ or DZ correlation (e.g., if MZ=DZ=.4, then 2 *.4=.8, and .8−.4=.4). Whatever is left over is taken to be attributable to the unshared environment (Alford et al. 2005).

While the basic tenets of the method remain the same, the techniques today are vastly improved. By using structural equation modeling, the variance of the phenotypic traits can be decomposed into an additive genetic component (A), a common environmental (C) or nonadditive genetic component (D), and a unique environmental component (E).[80] The ACDE decomposition is subject to the limitation that, with only MZ and DZ twin pairs reared together, nonadditive genetic and common environmental influences are confounded; thus separate ACE and ADE models are typically tested and compared.[81] This approach to the estimation of heritable and environmental variance is extensively used and earlier sets of these data have been analyzed in this manner in

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[80] See chapter 3 for a full examination of the variance components.

[81] For more on the confounding common environment and dominance please review chapter 3.

previous research (Martin et al., 1986; Truett et al., 1992; Neale and Cardon, 1992). However, previous studies examining social and political behaviors have not found significant nonadditive genetic components and preliminary analyses did not rebut those assertions; therefore only ACE models were examined in this study (Martin, 1987; Truett et al., 1992).

Preliminary Analyses

The observed frequencies for each of the ordinal phenotypic traits were calculated using SPSS 13 (SPSS Inc., 2004) and fit to a threshold model that assumes that each variable has an underlying normal distribution of liability (Neale and Cardon, 1992). The thresholds are expressed as z values which discriminate between categories that correspond to the frequency of the sociodemographic and political vote choice indicators. Thresholds were tested for similarity across sex and across twin zygosity groups. Thresholds were corrected for age effects.

Univariate genetic models using raw data were fit to the same political items and sociodemographic indicators as reported in Alford et al. 2005. However, unlike the initial analyses, Mx 1.60 (Neale et al., 2003) was used for genetic model fitting. Correlations between the latent additive genetic factors were 1 for monozygotic twins (MZ) and .5 for dizygotic twins (DZ), including opposite sex pairs (OS). Correlations between the latent common environment factors were 1 in both MZ and DZ twin pairs. As the data of opposite sex DZ twin pairs were available, unlike the Alford et al. examination, non-scalar sex-limitation models were used to analyze the data. Sex limitation models assume the same sources of variation for males and females, but allow for differences in the extent to which the same genetic and environmental factors influence a trait. Ninety-five percent confidence intervals for each element of A, C and E were estimated in Mx. Sex and age were also included in the threshold model to control for any relationship between these fixed effects and vote choice.

Sub-models and Model Fitting

Several models were fit to the data to test the possibility of different genetic and environmental components of each attitude. In order to determine the importance of the

A, C and E components, the full ACE models were tested against progressively reduced models. This method provides a significant advantage to the heritability design found in the Alford et al. (2005) analyses and is the accepted standard in the behavior genetics discipline (Rijsdijk and Sham. 2002; Neale and Maes 2006) . The significance of the variance components were assessed by testing whether dropping A or C reduced model fit. In addition, due to the availability of opposite sex pairs, nested models that equated the separate path coefficients for males and females were also examined and compared to the full sex limitation ACE model in order to test whether sex specific differences in the magnitude of the variance components provide a better model fit than without sex differences.

Results

The Heritability of Political Attitudes

Univariate models containing additive genetic, common environmental and unique environmental variance components were fitted to determine which model best explains each political attitude individually (Table 3). As such several models were examined, including: 1) equating thresholds for MZ and DZ pairs to verify there is no violation of equal environments assumption (EEA), 2) equating thresholds for males and females (testing for the need to correct for sex) and 3) equating the variance components for males and females to determine if sex difference exist in the estimates. In addition several reduced models were analyzed by removing the entire additive genetic component (A) or common environment component (C), or both for all items. Table 1 provides the results of the re-analyses of the US sample.

The Univariate analyses conducted for each of the individual political attitudes confirm Alford et al.'s initial finding. Using the most robust methods, analyses of seven of the attitudes (Death penalty, Draft, Moral majority, Property Tax, socialism, Unions, and Women's Lib) provide remarkable similar results (See Table 4 for a comparison with the original Alford et al. results).

In only 1 of the items examined by Alford et al. (2005) did a CE model (no genetic variance components present) fit best (party identification). While 17 of the 26 items examined were AE models (additive genetic and unique environment, but no familial socialization). As such, in most cases Alford et al. (2005) underreported the genetic effects (up to .21 differences -living together). However, only 12 of the items examined provided evidence that the variance components could be equated for males and females, thus showing the importance of a sex limitation model and need to include opposite sex twin pairs; something to which I will return to in a later chapter.[82] Models containing only unique environmental variances only (E model), fit significantly worse for all items.

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[82] The difference in male and female variance components will be explored further in chapter 7.

Table 4.3 (US) Standardized Variance Components (95% CI) Sex Limitation Model Fitting for Political Attitudes; Thresholds Corrected for Age[a]

		Parameter Estimates									
		Females			Males						
	Model	a^2	C^2	e^2	a^2	c^2	e^2	-2LL	ΔX^2	Δdf	p-value (comparison model)
Abortion	ACE[bc]	.26 (.12-.41)	.41(.27-.53)	.33 (.29-.37)	.38 (.16-.51)	.19 (.10-.37)	.43 (.36-.50)	23249.16	6.33	6	.38 (ACE)
Astrology	AE[b]	.47(.43-.47)	-	.53 (.48-.57)	.47 (.39-.54)	-	.53 (.46-.61)	24329.32	2.83	2	.24 (ACE)
Busing	ACE[b]	.31 (.16-.31)	.09 (.08-.20)	.60 (.55-.65)	.12 (0-.40)	.30 (.06-.45)	.58 (.50-.66)	22772.97	3.64	4	.46 (ACE)
Capitalism	AE[b]	.47 (.43-.52)	-	.53 (.48-.57	.61 (.54-.67)	-	.39 (.33-.46)	23031.11	5.08	2	.07 (ACE)
Censorship	AE[b]	.38 (.33-.42)	-	.62 (.58-.67)	.39 (.35-.47)	-	.61 (.53-.69)	24416.92	5.92	2	.05 (ACE)
Death Penalty	ACE[bd]	.35 (.22-.48)	.21 (.10-.31)	.44 (.40.-48)	.35 (.22-.48)	.21 (.10-.31)	.44 (.40.-48)	18872.82	0.29	3	.96 (ACE)
Divorce	ACE[bc]	.25 (.16-.29)	.23 (.08-.38)	.52 (.47-.57)	.42 (.31-.42)	0 (.00-.07)	.57 (.53-.65)	24253.99	10.35	6	.11 (ACE)
Draft	AE[bd]	.37 (.32-.41)	-	.63 (.60-.68)	.37 (.32-.41)	-	.63 (.60-.68)	22096.51	0.10	1	.75 (ACE)
Federal Housing	AE[b]	.41 (.36-.46)	-	.59 (.54-.64)	.41 (.36-.46)	-	.59 (.54-.64)	22455.92	5.49	2	.06 (ACE)
Foreign Aid	ACE[b]	.40 (.29-.45)	.01 (.00.-10)	.59 (.55-.64)	.31 (.08-.49)	.11 (.00-.31)	.58 (.51-.66)	25235.07	8.35	4	.08 (ACE)
Gay Rights	ACE[bd]	.34 (.24-.45)	.25 (.22-.34)	.41 (.39-.45)	.34 (.24-.45)	.25 (.22-.34)	.41 (.39-.45)	22434.67	5.02	3	.17 (ACE)
Immigration	AE[bd]	.46 (.46-.49)	-	.54 (.51-.54)	.46 (.46-.49)	-	.54 (.51-.54)	24832.82	1.02	1	.31 (ACE)
Living Together	ACE[bc]	.51 (.41-.68)	.16 (.10-.24)	.33 (.30-.37)	0 (.00-.34)	.48 (.21-.54)	.52 (.52-.58)	21940.29	6.82	6	.33 (ACE)
Military Drill	AE[bd]	.36 (.31-.40)	-	.64 (.63-.69)	.36 (.31-.40)	-	.64 (.63-.69)	21635.07	6.88	4	.14 (ACE)
Modern Art	AE[bcd]	.40 (.36-.43)	-	.60 (.57-.64)	.40 (.36-.43)	-	.60 (.57-.64)	25004.82	0.27	1	.61 (ACE)
Moral Majority	AE[bd]	.42 (.38-.47)	-	.58 (.53-.62)	.42 (.38-.47)	-	.58 (.53-.62)	24882.86	1.15	2	.56 (ACE)
Nuclear Power	AE[bd]	.34 (.30-.39)	-	.65 (.61-.65)	.34 (.30-.39)	-	.65 (.61-.65)	24577.93	5.99	2	.06 (ACE)
Pacifism	AE[bd]	.31 (.27-.35)	-	.69 (.65-.73)	.31 (.27-.35)	-	.69 (.65-.73)	22094.26	0.79	1	.94 (ACE)
Party Affiliation	CE[bcd]	-	.81 (.78-.84)	.19 (.16-.22)	-	.81 (.78-.84)	.19 (.16-.22)	8738.75	2.34	2	.31 (ACE)
Property Tax	AE[bd]	.42 (.41-.46)	-	.58 (.58-.63)	.42 (.41-.46)	-	.58 (.58-.63)	21227.90	0.00	1	.48 (ACE)
Religiosity-2	ACE[bc]	.56 (.35-.66)	.19 (.08-.39)	.25 (.21-.29	.22 (.00-.57)	.36 (.05-.59)	.41 (.32-.50)	15047.54	3.33	3	.34 (ACE)
School Prayer	ACE[b]	.32 (.16-.48)	.37 (.22-.51)	.31 (.27-.36)	.47 (.22-.62)	.21 (.09-.41)	.32 (.26-.40)	18018.47	4.66	4	.32 (ACE)
Segregation	AE[bcd]	.37 (.32-.37)	-	.63 (.59-.68)	.37 (.32-.37)	-	.63 (.59-.68)	20367.82	0.08	1	.78 (ACE)
Socialism	AE[bd]	.38 (.34-.38)	-	.62 (.58-.66)	.38 (.34-.38)	-	.62 (.58-.66)	21328.12	0.53	1	.46 (ACE)
Unions	AE[bd]	.41 (.36-.46)	-	.59 (.54-.64)	.41 (.36-.46)	-	.59 (.54-.64)	24884.86	4.34	2	.11 (ACE)
Women's Lib	ACE[bc]	.34 (.18-.49)	.18 (.05-.18)	.48 (.44-.53)	.31 (.23-.39)	0 (.00-.03)	.69 (.61-.76)	24217.86	8.22	6	.22 (ACE)
X-Rated Movies	AE[bcd]	.51 (.47-.56)	-	.49 (.46-.54)	.51 (.47-.56)	-	.49 (.46-.54)	18652.25	0.79	2	.67 (ACE)

Note: (a) Only best fitting models shown. (b) Equated Thresholds for MZ and DZ pairs (no violation of EEA). (c) Equated Thresholds for Males and Females, MZ and DZ twins. (d) Equated Variance components for Males and Females.

Table 4.4. Comparison of Alford et al. (2005) results with Hatemi (2007) results

	AFH 2005			Hatemi 2007 (Males and Females separately)						
	All Models ACE, No sex Diff			Note: (a) Only best fitting models (b) Equated Thresholds for MZ and DZ pairs (no EEA violation) (c) Equated Thresholds for Males and Females (d) Equated Variance components for Males and Females						
Attitude Item	a^2	c^2	e^2	Model^a	a^2 (95% CI)	c^2 (95% CI)	e^2 (95% CI)	a^2 (95% CI)	c^2 (95% CI)	e^2 (95% CI)
Abortion	.25	.39	.36	ACE^{bc}	.26 (.12-.41)	.41(.27-.53)	.33 (.29-.37)	.38 (.16-.51)	.19 (.10-.37)	.43 (.36-.50)
Astrology	.39	.09	.52	AE^b	.47(.43-.47)	-	.53 (.48-.57)	.47 (.39-.54)	-	.53 (.46-.61)
Busing	.26	.16	.58	ACE^b	.31 (.16-.31)	.09 (.08-.20)	.60 (.55-.65)	.12 (0-.40)	.30 (.06-.45)	.58 (.50-.66)
Capitalism	.39	.14	.47	AE^b	.47 (.43-.52)	-	.53 (.48-.57	.61 (.54-.67)	-	.39 (.33-.46)
Censorship	.30	.10	.60	AE^b	.38 (.33-.42)	-	.62 (.58-.67)	.39 (.35-.47)	-	.61 (.53-.69)
Death Penalty	.32	.24	.44	ACE^{bd}	.35 (.22-.48)	.21 (.10-.31)	.44 (.40.-48)	.35 (.22-.48)	.21 (.10-.31)	.44 (.40.-48)
Divorce	.25	.21	.54	ACE^{bc}	.25 (.16-.29)	.23 (.08-.38)	.52 (.47-.57)	.42 (.31-.42)	0 (.00-.07)	.57 (.53-.65)
Draft	.38	.02	.60	AE^{bd}	.37 (.32-.41)	-	.63 (.60-.68)	.37 (.32-.41)	-	.63 (.60-.68)
Federal Housing	.20	.15	.65	AE^b	.41 (.36-.46)	-	.59 (.54-.64)	.41 (.36-.46)	-	.59 (.54-.64)
Foreign Aid	.35	.06	.59	ACE^b	.40 (.29-.45)	.01 (.00.-10)	.59 (.55-.64)	.31 (.08-.49)	.11 (.00-.31)	.58 (.51-.66)
Gay Rights	.28	.32	.40	ACE^{bd}	.34 (.24-.45)	.25 (.22-.34)	.41 (.39-.45)	.34 (.24-.45)	.25 (.22-.34)	.41 (.39-.45)
Immigration	.33	.12	.55	AE^{bd}	.46 (.46-.49)	-	.54 (.51-.54)	.46 (.46-.49)	-	.54 (.51-.54)
Living Together	.30	.37	.33	ACE^{bc}	.51 (.41-.68)	.16 (.10-.24)	.33 (.30-.37)	0 (.00-.34)	.48 (.21-.54)	.52 (.52-.58)
Military Drill	.29	.09	.62	AE^{bd}	.36 (.31-.40)	-	.64 (.63-.69)	.36 (.31-.40)	-	.64 (.63-.69)
Modern Art	.25	.16	.59	AE^{bcd}	.40 (.36-.43)	-	.60 (.57-.64)	.40 (.36-.43)	-	.60 (.57-.64)
Moral Majority	.40	.03	.57	AE^{bd}	.42 (.38-.47)	-	.58 (.53-.62)	.42 (.38-.47)	-	.58 (.53-.62)
Nuclear Power	.26	.16	.58	AE^{bd}	.34 (.30-.39)	-	.65 (.61-.65)	.34 (.30-.39)	-	.65 (.61-.65)
Pacifism	.38	-.04	.66	AE^{bd}	.31 (.27-.35)	-	.69 (.65-.73)	.31 (.27-.35)	-	.69 (.65-.73)
Political Affiliation	.14	.41	.45	CE^{bcd}	-	.81 (.78-.84)	.19 (.16-.22)	-	.81 (.78-.84)	.19 (.16-.22)
Property Tax	.41	.06	.53	AE^{bd}	.42 (.41-.46)	-	.58 (.58-.63)	.42 (.41-.46)	-	.58 (.58-.63)
Religiosity	-	-	-	ACE^{bc}	.56 (.35-.66)	.19 (.08-.39)	.25 (.21-.29	.22 (.00-.57)	.36 (.05-.59)	.41 (.32-.50)
School Prayer	.41	.25	.34	ACE^b	.32 (.16-.48)	.37 (.22-.51)	.31 (.27-.36)	.47 (.22-.62)	.21 (.09-.41)	.32 (.26-.40)
Segregation	.27	.11	.62	AE^{bcd}	.37 (.32-.37)	-	.63 (.59-.68)	.37 (.32-.37)	-	.63 (.59-.68)
Socialism	.36	.07	.57	AE^{bd}	.38 (.34-.38)	-	.62 (.58-.66)	.38 (.34-.38)	-	.62 (.58-.66)
Unions	.37	.07	.56	AE^{bd}	.41 (.36-.46)	-	.59 (.54-.64)	.41 (.36-.46)	-	.59 (.54-.64)
Women's Lib	.33	.13	.54	ACE^{bc}	.34 (.18-.49)	.18 (.05-.18)	.48 (.44-.53)	.31 (.23-.39)	0 (.00-.03)	.69 (.61-.76)
X-rated	.35	.28	.37	AE^{bcd}	.51 (.47-.56)	-	.49 (.46-.54)	.51 (.47-.56)	-	.49 (.46-.54)

In addition, as previously noted in chapter 3, the most common social science criticism of the twin method is the equal environment assumption. Note that all items examined were able to equate the thresholds for MZ and DZ twins thus providing no evidence that the EEA was violated.[83]

Converging Evidence: the Australian Data

The Australia data set available contains 11 of the exact same questions and response option used in the US study and due to the similar cultural and biological roots for both societies, the samples are ideal for comparison. The variance components for Seven of the 11 items were nearly identical in model and variance component estimates between the US and AUS sample, while the remaining 4 were not far off (Table 5). In essence, though some differences existed, both the US and Australian data provide supporting evidence of a genetic component to political attitudes, and again no evidence of any violation of the EEA.

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[83] See chapter 3 for more detail on the equal environment assumption.

Table 4.5. (AUS) Standardized Variance Components (95% CI) Sex Limitation Model Fitting for Political Attitudes; Thresholds Corrected for Age[a]

		Parameter Estimates									
		Females			Males						
	Model	a^2	C^2	e^2	a^2	c^2	e^2	-2LL	ΔX^2	Δdf	p-value (comparison)
Abortion	ACE[bc]	.42 (.25-.60)	.21 (.05-.35)	.37 (.32-.43)	.42 (.25-.60)	.21 (.05-.35)	.37 (.32-.43)	10145.61	3.90	3	.27 (ACE)
Censorship	ACE[b]	.36 (.22-.44)	0 (.00-.10)	.64 (.56-.73)	.14 (.00-.45)	.30 (.01-.49)	.58 (.47-.68)	11100.99	5.33	4	.25 (ACE)
Death Penalty	AE[bd]	.55 (.50-.60)	-	.45 (.40.50)	.55 (.50-.60)	-	.45 (.40.50)	11367.48	1.24	4	.87 (ACE)
Divorce	ACE[bcd]	.20 (.01-.39)	.22 (.06-.37)	.58 (.52-.65)	.20 (.01-.39)	.22 (.06-.37)	.58 (.52-.65)	11318.54	1.59	3	.66 (ACE)
Gay Rights	ACE[bd]	.37 (.20-.55)	.15 (.01-.30)	.47 (.42-.53)	.37 (.20-.55)	.15 (.01-.30)	.47 (.42-.53)	11828.90	0.50	3	.92 (ACE)
Immigration	ACE[bd]	.37 (.20-.53)	.12 (.00-.26)	.51 (.45-.56)	.37 (.20-.53)	.12 (.00-.26)	.51 (.45-.56)	12820.38	2.99	3	.39 (ACE)
Modern Art	AE[bcd]	.42 (.36-.48)	-	.58 (.52-.64)	.42 (.36-.48)	-	.58 (.52-.64)	12205.00	376	0	.74 (ACE)
Nuclear Power	AE[bd]	.40 (.34-.45)	-	.60 (.55-.66)	.40 (.34-.45)	-	.60 (.55-.66)	11731.47	0.65	1	.42 (ACE)
Religiosity	ACE[bcd]	.37(.21-.54)	.28 (.13-.41)	.35 (.30-.40)	.37(.21-.54)	.28 (.13-.41)	.35 (.30-.40)	1.17	3		.62 (ACE)
Socialism	AE[bcd]	.39 (.34-.44)	-	.61 (.56-.66)	.39 (.34-.44)	-	.61 (.56-.66)	5.82	4		.71 (ACE)
Unions	AE[bcd]	.45 (.40-.50)	-	.55 (.50-.60)	.45 (.40-.50)	-	.55 (.50-.60)	-	-		.06 (ACE)

Note: (a) Only best fitting models shown. (b) Equated Thresholds for MZ and DZ pairs (no violation of EEA). (c) Equated Thresholds for Males and Females, MZ and DZ twins. (d) Equated Variance components for Males and Females.

Conclusion and Discussion

The evidence provided supports the claim that many political attitudes and behaviors are heritable and do have a genetic component. While these same data have been previously examined in different manners (Martin et al. 1986; Truett et al. 1992; Eaves et al. 1999; Alford et al. 2005), this examination utilizes the most recent classical twin design including opposite sex twin pairs to validate earlier findings and examines each item individually, not found in the more recent behavior genetics literature. In short, while the Alford et al. (2005) analyses utilized less complex methods, their biggest crime was the lack of model fitting and lack of differentiation between males and females. This does not mean that the overall findings were incorrect; rather they were not as specific as they could have been.

However, importantly, many of the results did change with the updated methods. Party affiliation was shown to have no genetic effect, and common environment was eliminated from more than half of the items examined; a major change from Alford et al. (2005). Furthermore, male and female variance components were different; very different in some cases. This difference could not be tested without the inclusion of opposite sex twin pairs, thus providing a strong validation for their inclusion in all future analyses.

However even with these revelations, the classical twin design itself may not be the best method to analyze social and political attitudes. More advanced techniques incorporating parental and non twin sibling data may provide further insight. Parental data allows for the examination of assortative mating, which in previous analyses of social items such as Church attendance (Truett et al. 1994), Conservatism, Religious opinions and Sexual attitudes (Eaves et al. 1999) reduced familial socialization (C) and increased the genetic component (Coventry and Keller 2005). While not available for this particular study at this time, future analyses of these data should be performed including parents and additional sibs in the sample to control for assortative mating and provide an even stronger test of the EEA.

The classical twin design has previously come under critical scrutiny for underestimating the genetic effect (Tesser 1993; Crelia and Tesser 1996), particularly with the growing recognition that individuals shape their own environments (Scarr 1996; Bouchard 1997). While the twin analyses in this design does not test for Scarr's (1993) concerns, it nevertheless offers a "first base" so to speak, to examine family influence to determine if genetic factors explain at least part of the variance in any given trait. Based upon the works of Lindon Eaves, Nick Martin, John Alford, John Hibbing, and now this study, clearly the twin design offers us an intriguing first look and the results give us a reason to look further.

Chapter 5 - The Genetics of Party Identification and Vote Choice

Numerous studies have shown evidence for genetic influences on social and political attitudes (Martin et al. 1986; Truett et al. 1992; Eaves et al. 1998; Eaves et al. 1999). Large scale studies of US and Australian twins that utilized responses to the Wilson-Patterson Conservatism Scale found a moderate contribution of genetic factors in the variation of political opinions (Martin et al. 1986). Opinions on abortion, immigration, death penalty, euthanasia, conservatism, authoritarianism as well as behaviors such as religiosity and educational attainment have been found to be significantly genetic; while individual differences in specific religious affiliation are primarily environmental in origin (Eaves et al. 1989; Olson et al. 2001; Bouchard et al. 2003). In the previous chapter these results were confirmed using the most recent and robust classical twin design methods.

More recently, the genetics of political attitudes, partisanship and voting has received renewed interest. Alford et al.'s (2005) publication in the American Political Science Review (APSR) "Are Political Orientations Genetically Transmitted?" summarized and recast previous findings in the behavior genetics discipline by Lindon Eaves and Nick Martin into a social science frame. The attention in the social sciences and mass media was significant, and the authors were told that the article quickly became the most viewed and downloaded in APSR history (Alford and Hibbing 2006b). Although the study was heralded as possibly among the "the most important articles the APSR has ever published" (Sigelman 2006), the study principally focused on political attitudes and did not address the source of partisanship (but did provide heritability, common and unique environment estimates), strength of partisanship or the pinnacle of political behaviors, vote choice.

This chapter addresses the sources of variance for these three aforementioned issues in separate sections by testing the main theories for political behavior, both rational choice and the socio-psychological approach (Michigan School), by identifying both environmental and genetic variance components.

Party Identification

Campbell et al.'s (1960) seminal work, *The American Voter*, describe voters as an unsophisticated electorate, emphasizing the importance of partisan loyalties. Americans' attachment to political parties supersedes voting behavior in any given election; the public is unsophisticated, has non-attitudes, lacks issue positions and has low constraints and therefore low stability. The party is more significant and stable than policy issues (Campbell et al. 1960; Converse 1964). In essence, the public votes for the party they belong to, which is determined by their family.

Yet the weakening of partisan ties, unpopular government policies, and importance of personal traits of candidates, high profile issues and world events were not discounted (Converse et al. 1965). Since the 1960's Converse contends the probability that any given voter will be deflected to cross party lines varies "inversely as a function of the mass of stored information about politics" (Converse 1967:141), which leads to a more "rational choice" view of party identification. While other studies maintain voters simply cast a party vote; a voter's identification with his or her party remains constant but can and will alternate their vote as a result of a momentary partisan evaluation (Cowart 1973).[84] In essence, the party is the most stabilizing force, but defections happen based on environmental conditions, or what Campbell et al. (1960) called "deviation."

Later works supported this view that Americans are "reasonably ideological" and policy issues have an effect on vote choice. Ideological awareness increased since 1950's and issue voting (weight of policy preference) increased while partisanship declined (Nie et al. 1974). There were major increases in the levels of attitude consistency during the 1960s and 1970s and during this period, "Americans were bombarded with one social and political crisis after another." Nie et al. (1974) argue that the increase in high profile political events caused the electorate to perceive politics as increasingly central to their

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[84] For example Republicans can vote for Democrats if dissatisfied with the Republican's foreign policy agenda.

lives and this increased salience of political events placed significant pressure on voters to force their inconsistent beliefs into coherence. As such, if events are more salient to the public, the public expresses higher levels of attitude consistency, therefore the "times" matter and voters could change their normal party of preference and corresponding vote due to specific salient issues;[85] thus continuing the gradual move to rational choice.

Fiorina (1981) continued to challenge the earlier works of Campbell and Converse by finding that party identification (PID) is not necessarily a deep-seated stable characteristic. Although PID is not unstable, it is not set in stone; rather it is less stable than previously thought and is influenced by political experiences. Campbell and others emphasized PID shaped a voter's interpretation of events, but Fiorina suggests that events shape a voter's party identification. A citizen's PID alternates in accordance with their perceptions of societal conditions, political events, and the performance of the officeholder(s).[86] In short, partisanship is a continuous summary of retrospective and prospective evaluations, based on socialization, historical effects, and evaluations of current events. Partisanship is continuously challenged as new information is presented to the voter populace.[87]

Fiorina assumes a more "rational" model in that the public chooses the party based upon new information and socialization. Fiorina's partisanship model closely resembles the 1950's Anthony Downs economic model of voter behavior, where voters

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[85] Morris Fiorina (1981) distinguishes between prospective voting, in which the electorate vote for the candidate or party making the best promises for the future, and retrospective voting, in which the electorate vote on the basis of past party performance and showed that evaluations of past party performances were more important in voting than candidate's promises for the future. There may also be increased rational and strategic voting by 'retrospective voting' on the basis of past achievement (Fiorina 1996). Miller and Wattenberg (1985) supported Fiorina's assertions and found that presidential incumbents were indeed judged primarily on retrospective performance grounds, though challengers were judged more in terms of prospective policy, and prospective performance predominated in races in which an incumbent did not run for reelection. Anthony Downs (1957) earlier work also suggested that the electorate could vote out a party that has not performed well which was later turned out to be case when Reagan was elected from Carters failures.

[86] Although PID can change due to short term forces, the best indicator of PID is what it was four years ago (Fiorina 1981).

[87] More recent work from Popkin (1991) supports this view finding PID is stable but vote choice can change as a result from a change in the candidate's evaluations by the voter.

choose the candidate or party closer to their policy preference (Downs 1957), but Fiorina utilizes retrospective (evaluative) opinions as well as imply that preferences are influenced by familial socialization. According to Downs, voters are positioned in a one-dimensional space and choose between parties located in the same space. Voters know where they are, observe where each of the parties are, and vote for the candidate in the party closest to their own issue space. In other words, voters choose between parties on the basis of their issue platforms; these platforms represent positions on an ideological scale. Each citizen has fixed preferences and votes for the party closest to his or her preferences; therefore rational parties move toward the center of issue platforms in order to be attractive to the largest voter distribution (Downs 1957).

Ideology , Partisanship and Vote Choice

Since Campbell et al.'s (1960) findings in *The American Voter* and Converse's (1964) seminal paper, the investigation for ideological dimensions underlying PID and voting has gained significant attention from political behavior scholars. Although Campbell et al. and Converse found low levels of ideological consistency, sophistication and constraint, later work has found increased ideological awareness, which is reflected in the relationship between ideology, PID and vote choice. A majority of the literature regarding vote choice focuses on partisanship rather than ideology, however several studies have shown that beginning with the Johnson-Goldwater presidential election of 1964, political ideology (including issues positions) has become an increasingly important determinant of PID and vote choice (Nie et al. 1979). Conover and Feldman (1981) suggest ideology should not be "structured in dimensional terms", but viewed as it is commonly used in our political system. People choose their party or candidate based on their feelings toward liberals and conservatives. This feeling may not be issue oriented, but based on emotion or recognition of key political symbols, thus influencing the public's opinion on political issue positions. Regardless of the directional relationship between issues and ideology, vote choice is affected by partisanship, which is influenced by the public's ideological feelings.[88]

Typically, in the U.S. ideology is measured on a scale with conservative on one end and liberal on another. Ideologies are most closely associated with our two-party system: liberals on the left (Democrats) and conservatives on the right (Republicans). Using data provided by the American National election Studies cumulative file 1948-2000, there is a .405 correlation between ideology and partisanship (Sapiro et al. 2002).[89] By performing a simple cross tab between partisanship and ideology, one can see that there is a strong relationship between Liberals and Democratic affiliation and Conservatives and Republican affiliation (see Figures 1 and 2). Furthermore this relationship is increasing in strength since 1972 with the most substantial increases since 1990.[90]

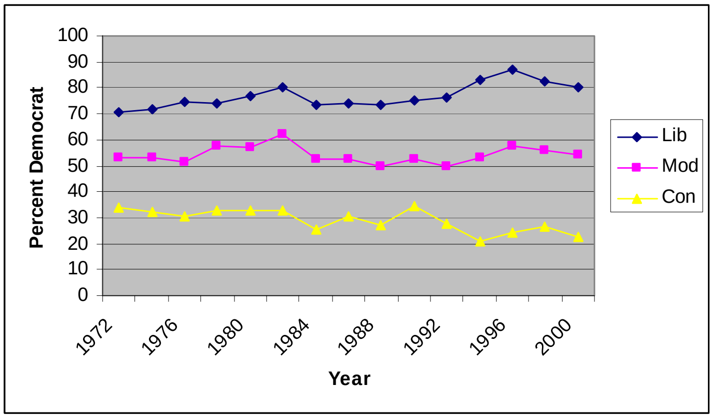

Figure 5.1 – Ideology and Democratic Partisan Affiliation
Source: NES Cumulative File 1948-2000

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[88] Erikson and Tedin (1994) argue that the reason for this ideological increase is that our two major parties have become increasingly polarized on liberal vs. conservative lines.

[89] Significant at the .01 level.

[90] The cross tabular data was available for 1972 to 2000; only cases where the respondent supplied an answer to the ideology question were included.

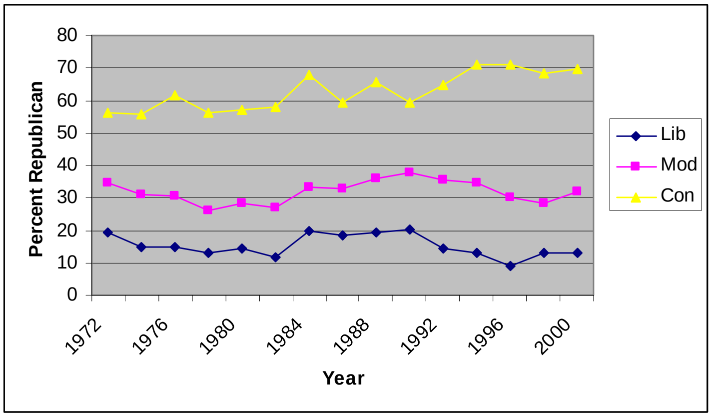

Figure 5.2 – Ideology and Republican Partisan Affiliation
Source: NES Cumulative File 1948-2000

Based upon the literature and survey evidence, ideology (whether issue positions or "feelings") and partisanship are related (Nie et al. 1974; Fiorina 1981); furthermore significant evidence in both recent and previous scholarship find party identification (PID) is a key determinant in vote choice (Campbell et al. 1960). Although implied, missing in the scholarly discourse is the explicit debate over the specific source of partisanship. While the "Michigan school", based upon Campbell's works that describe the strong correlation between parents and children in partisanship assume PID is largely attributed to familial socialization factors, (Campbell et al. 1960; Page and Jones, 1979; Carmines and Stimson, 1980), the rational or economic models base party identification on the result of rational choices made by self-interested utility-maximizing individuals who select party based upon individual preferences (Downs 1957; Fiorina 1981; Lichbach 2003). In essence, in the party identification literature the source is either familial upbringing (common environment), or issue position/feeling based (unique environment). However the question of whether there are intrinsic sources of party identification and vote choice remains.

The political preferences of family members, husbands and wives, parents and siblings and co-siblings are highly correlated (see Table 1 for familial correlations of party identification). These relationships are explained in the traditional literature as a result of familial socialization. Empirical rational choice examinations even go so far as to model intergenerational transmission of party identification. Achen (2002) asserts that party identification is the estimate of average future benefits from candidates of that party and finds voters update this expectation using political events but new voters, who have no previous experience rationally choose to make use of parental experience to politically orient themselves. In essence Achen (2002) not only uses the family but intergeneration familial transmission of political socialization, with no consideration to intergeneration transmission of genes.

Table 5.1 Twin Correlations for Party ID, Sociodemographic Traits and Political Attitudes

Item	Nuclear families								Twin pairs				
	Spouse	Parent-offspring				Sibling			Dizygotic			Monozygotic	
	H-W	M-D	M-S	F-D	F-S	MM	FF	MF	DZM	DZF	DZOS	MZM	MZF
Party ID (Rep v Dem)	.94	.86	.78	.82	.79	.72	.68	.68	.79	.80	.76	.82	.84
N Pairs for PID and Correlates [a]	722	10451	6584	10393	6124	846	1843	4962	610	1273	1397	826	2029

Note: (a) Correlations were estimated for full information maximum likelihood observations on relative pairs.

Hence we must ask, is party identification transmission only parental socialization or is PID partially determined by your familial genes? If genetic influences are present, are the genetic influences on ideological issue positions influencing party identification as Fiorina's socialization findings imply? Or is party ID driven only by your family upbringing as Campbell suggests? Furthermore, the traditional political science methods either do not address the source of variance or specifies the label of an item as either a socialization item (socio-economic class) or a unique experience item (service in the Army etc). However this view is incorrect, as any item has the potential for common and unique components as well as a genetic component.

Recent scholarship outside of political science provides both the theoretical and empirical bases for testable hypotheses to answer the aforementioned questions and address our traditional shortcomings. By utilizing the classical twin design as explained in chapter 3, this analysis decomposes the variances into familial socialization, unique experience and additive genetic effects for partisanship and tests the validity of mainstream political theories to see if the source of partisanship is due to familial socialization or unique experience, both, or neither (genes). Those in the field of behavior genetics have run limited analyses on party identification (Eaves et al. 1986), but they did not examine the nature of the relationship between political affiliation, issues positions or social indictors.[91] Furthermore, if PID does contain significant additive genetic or common environmental effects, it is unclear whether the heritable or socialization components can be accounted for through the genetic or familial influence on related social and political traits, or if there exists a unique genetic or common environmental component specific to party identification.

Hypotheses

While no specific multivariate investigations of party identification have been performed in the behavior genetics discipline, other group affiliations similar to political affiliation, such as religious affiliation have. Numerous studies examining religion and religiosity (church attendance), in both univariate and multivariate analyses, find that while religiosity (religious attendance) has a significant additive genetic component, the specific religion one chooses does not. In fact which religion one prescribes to is almost entirely due to familial socialization. If your parents are Zoroastrian, it is highly likely you will be Zoroastrian for no other reason than that you were raised by parents that way (common environment) (Martin et al. 1986; Eaves et al. 1989; Truett et al. 1992; Eaves 2006). Since party affiliation is just another form of group identification similar to religion, my first hypothesis to be tested in this chapter is that party identification is primarily due to familial socialization based specifically on partisanship, and not due to specific ideological issues positions, or to genes. While this position is taken by the vast majority of examinations of partisanship, it remains untested.

Methods

Sample

The data are from the same as utilized in chapter 4 and were collected in the late 1980's by the Virginia 30,000 Health and Life-Style Survey for Twins recruited from the

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[91] Alford et al 2005 also utilize polychoric correlations on these previously analyzed data.

Virginia population based twin registry and the American Association of Retired Persons (Eaves et al. 1999).[92]

Measures

The primary phenotype of party identification (PID) is assessed by the questionnaire item: "Political Affiliation." Under this heading respondents were asked "Under each topic below write in the number which best describes [your] Political Affiliation: (1) Don't know (2) Always supports Republicans (3) Usually supports Republicans (4) Varies (5) Usually supports Democrats (6) Always supports Democrats (7) Other (8) Prefer not to Answer. Twins were asked to report for "You, Your Twin, Your mother, Your father, Your spouse". Only self-reports are analyzed here. Based upon the nature of US politics several variables were created from this question. For Direction of Party ID, all analyses were performed utilizing a dichotomous variable of either identifying with Republicans (2-3) or Democrats (5-6).[93] Respondents who responded in the "Other" and "Prefer not answer" categories (10%) were set to missing, and those who chose "Varies" were set to "Independent". In addition to PID, a number of other sociodemographic variables and political attitudes potentially related to partisanship were analyzed. Traditional sociodemographic PID correlates including age, income, education, religion, occupation, marital status and church attendance (Campbell et al. 1960; Popkin 1991) were assessed (Table 2). Date of birth, originally a continuous variable, was used to divide the respondents into seven age groups routinely used for vote choice studies in the political science literature (18-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75+) (Sapiro et al. 2002). Political attitudes (ideological issue positions) were assessed utilizing a modified version of the 50-item attitude checklist used to construct the Wilson-Patterson (1968) Conservatism Scale as described chapter 4.

Preliminary Analyses

Phenotypic frequencies and descriptive statistics using raw data were calculated using SPSS 13 (SPSS Inc. 2004). As I plan to conduct multivariate analyses with

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[92] For demographics, response rate and more detail on the sample please review chapter 4.

[93] Analyses using a 3 item variable including "varies" as independents were also performed for validity and provided similar results. However, due the imprecise measurement of varies versus independent, these results are not reported.

ideological issue positions and PID, it is important to select items that empirically make sense. As such, in order to distinguish which political traits best correlate with PID, discriminant function analyses using all 28 ideological issue items from the VA30K version of the revised Wilson-Patterson Conservatism scale was used. The smaller the Wilks's lambda, the more important the independent variable is to the discriminant function. The standardized discriminant function coefficients serve the same purpose as beta weights in multiple regression and indicate the relative importance of the independent variable in predicting the dependent variable (PID). Using these two measures I selected the best predictors for PID.

As stated, multivariate analyses will be used to determine the degree of the relationship between sociodemographic traits, political attitudes and PID. Therefore, separate polychoric correlations by twin pair zygosity and opposite sex twin pairs were calculated for each of the phenotypic traits using Mx 1.60 (Neale et al. 2003). Polychoric correlations between PID and the selected sociodemographic and political items were also calculated using Mx 1.60 (Neale et al. 2003) for males and females separately (95% CI).

The observed frequencies for each of the ordinal phenotypic traits were fit to a threshold model that assumes that each variable has an underlying normal distribution of liability (Neale and Cardon 1992). The thresholds are expressed as z values which discriminate between categories that correspond to the frequency of the sociodemographic and PID correlates. Thresholds were tested for similarity across sex and across twin zygosity groups. Thresholds were corrected for age effects.

Table 5.2: Distribution of Age, Education, Income, Religious Denomination and Church Attendance by PID (%)

	Republican	**Independent**	**Democrat**
Strong Affiliation	31.3		23.4
Weak Affiliation	68.7		76.6
Age			
Mean	51	46	53
SD	18	16	17
Sex			
Male	44	40	38
Female	56	60	62
Education			
< 7 years	.89	.87	2.15
8 years	2.17	1.46	3.43
9-11 years	5.99	7.27	9.52
High School Diploma	26.36	30.95	28.44
College (1-3 years)	27.48	27.69	21.46
College graduate or better	37.11	31.76	35.01
Income			
< 5000	1.70	1.43	2.10
<10000	2.73	2.99	4.53
<15000	5.82	6.58	8.66
<20000	7.52	7.69	9.21
<25000	9.02	10.65	10.73
<35000	18.38	21.31	19.89
<50000	21.73	23.81	20.34
>50000	33.10	25.54	24.55
Religious denomination			
Catholic	12.35	15.89	20.05
Protestant	75.61	65.60	55.44
Jewish	1.22	3.22	9.22
Other	8.05	11.03	8.39
None	2.77	4.26	6.90
Church attendance			
2+ per Week	17.30	14.04	13.06
Weekly	31.98	27.09	28.73
Monthly	11.47	11.46	10.21
Yearly	15.92	18.73	18.38
Rarely	17.33	21.22	19.80
Never	6.00	7.45	9.83
N	10772	9443	6777

Univariate Analyses

While significant twin correlations establish a familial relationship, they cannot distinguish between genetic and environmental effects, or separate between common or unique environmental effects. However, as explained in detail in chapter 3 by using structural equation modeling, the variance of the phenotypic traits can be decomposed into an additive genetic component (A), a common environmental (C) or nonadditive genetic component (D), and a unique environmental component (E). The ACDE decomposition is subject to the limitation that with only MZ and DZ twin pairs reared together nonadditive genetic and common environmental influences are confounded; thus separate ACE and ADE models are typically tested and compared. This approach to the estimation of genetic and environmental variance is extensively used, and earlier sets of these data have been analyzed in this manner in previous research (Martin et al. 1986; Truett et al. 1992; Neale and Cardon 1992). Previous studies examining social and political behaviors have not found significant nonadditive genetic components, and initial examinations of the polychoric correlations showed no evidence of dominance.[94] Thus only ACE models were examined in this study (Martin 1987; Truett et al. 1992).

Univariate genetic models using raw data were fit to PID, sociodemographic indicators and the political items selected based upon the findings in the discriminant analyses. Mx 1.60 (Neale et al. 2003) was used for genetic model fitting. Correlations between the latent additive genetic factors were 1 for monozygotic twins (MZ) and .5 for dizygotic twins (DZ), including opposite sex pairs (OS). Correlations between the latent common environment factors were 1 in both MZ and DZ twin pairs. As the data of opposite sex DZ twin pairs were available, non-scalar sex-limitation models were used to analyze the data. Sex limitation models assume the same sources of variation for males and females, but allow for differences in the extent to which the same genetic and environmental factors influence a trait. Ninety-five percent confidence intervals for each element of A, C and E were estimated in Mx. Sex and age were also included in the threshold model to control for any relationship between these fixed effects and PID.

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[94] The MZ correlations were at least twice as large as the DZ correlations in any of the items examined.

Zygosity

Twin zygosity was determined by two self report items. This method has been shown to provide probably better than 95% agreement with blood typing (Martin and Martin 1975; Eaves et al. 1986).

Multivariate Analyses

Multivariate analysis permits both the determination of sources of covariation and the structure in which the related phenotypic traits influence PID. Several Cholesky decompositions were used to assess the extent to which the heritable and environmental components of PID were explained by (1) the genetic and environmental influences shared with the selected sociodemographic indicators and political attitudes and (2) the genetic and environmental influences not shared with sociodemographic indicators and political attitudes and therefore specific to PID.

In the Cholesky decomposition, the number of additive genetic, common environment and unique environmental elements are equal to the number of phenotypic traits (Neale and Cardon 1992). Variance is partitioned to estimate the proportion of the genetic, common environment and unique environmental variance of all variables in subsequent order beginning with the variance of the first variable. The second variable in the model is assumed to be caused by a second latent factor that also explains part of the variance of the five remaining variables, and so on (Loehlin, 1996). As the object of this analysis is to explain the heritability and environmental variance of party identification, the last variable in the Cholesky decomposition is PID, which is assumed to be caused by a seventh latent factor explaining the variance of PID that has not yet been explained by the variance of all of the previous latent factors in the analyses (Truett et al. 1992). Similar to the univariate analysis, Mx 1.60 (Neale et al. 2003) was used for the Cholesky decomposition.

Sub-models and Model Fitting

Several models were fit to the data to test the possibility of different genetic and environmental components of PID. For both the univariate and multivariate analyses, in order to determine the importance of the A, C and E components, the full ACE models were tested against progressively reduced models. The significance of the variance components was assessed by testing whether dropping A or C reduced model fit. Due to the availability of opposite sex pairs, nested models that equated the separate path coefficients for males and females were examined and compared to the full sex limitation ACE model in order to test whether sex specific differences in the magnitude of the variance components provide a better model fit than without sex differences.

For the multivariate analyses several reduced models were tested against the full Cholesky to identify the best fitting and most parsimonious model for males and females. All factor loadings were first estimated in full Cholesky decomposition; tests of their significance were conducted by setting them to zero and re-estimating the other parameters (reduced models). The nested models were simplified by determining whether the removal of successive individual parameters resulted in a significant worsening fit of the model to the data. These reduced models include removing the additive genetic variance components from specific trait paths related to PID.

Model fit is assessed by using the -2 log likelihood (–2LL), chi-square statistic, associated p-value, and Akaike's Information Criterion. Model fit is evaluated by comparing the –2LL of the saturated model to the reduced nested models. Nested models were compared using likelihood ratio tests (Δ–2LL), where a significant increase in –2LL indicates a worsening of model fit. Akaike Information Criterion (AIC), a goodness-of-fit measure (AIC = –2LL minus twice the degrees of freedom) is also used to compare model fit and parsimony between nested models. As the resulting -2LL is chi-square distributed, the goodness of fit of the model can be assessed by comparing the -2LL with the degrees of freedom being equal to the difference between the number of parameters estimated in the different models. A non-significant difference in chi-square is indicative that the more parsimonious model is a better fitting model. In the case of comparisons between non-nested models, the most parsimonious of these models is the one with the lowest AIC (Akaike 1987; Neale and Cardon 1992).

Results

PID was answered by 27042/29691 (91%) individuals. Because of missing values for covariates, the use of only Republican and Democrat affiliation, and the use of only twin pairs in the SEM variance analyses, the numbers for most analyses will be smaller. Using only twins, Republicans accounted for 40% of the sample, Independents 35% and Democrats 25%. The total sample was 59.7% female and 41.3% male, thus our sample favored females and Republicans. The age range was 16-94 (mean = 49, standard deviation = 17.6); the mean age was 51 years old for Republicans, 46 for independents and 53 for Democrats. Educational levels were near identical for Republicans and Independents, but there was a 6% difference in Democrats having a high school or above education (Table 2). More Republican and Independents were considered middle income (73 and 71% respectively), while only 65% of Democrats reported having a middle income or greater. Republicans were significantly more religious than Democrats and Independents, with 97% identifying with a religion, and 61% attending religious services at least once a month, while Democrats and Independents were slightly less likely to identify with a religion (95% and 93% respectively) but significantly less likely to regularly attended church (52% and 53% respectively).

Discriminant Analysis

Table 3 presents the political items that most discriminate between party identification. Comparing Republican and Democrat supporters, attitudes on unions, school prayer, nuclear power, gay rights, death penalty, federal housing, moral majority, women's liberation, socialism and busing had both the lowest Wilks' Lambdas and the highest standardized function coefficients, indicating they are the strongest discriminators. Republican supporters tended to be in favor of the death penalty, school prayer, and the moral majority, and against unions, gay rights, and federal housing. Democrat supporters are much more favorable to women's liberation, socialism, busing, gay rights and oppose school prayer. A second discriminant analysis (not displayed) found that there were no significant discriminators distinguishing partisans (Democrat and Republican supporters) from independents (varies).

Based upon these results, the following six variables were identified as most strongly associated with partisan support (Rep. vs. Dem.): one sociodemographic indicator, church attendance, as well as five political attitudes on school prayer, gay rights, death penalty, unions, and federal housing. Nuclear power, though a strong discriminator, was left out of further analyses due to the possibility that this item could be misconstrued by respondents.[95]

Table 5.3: Attitude Items that Best Discriminate Between Republican and Democrat (PID)

	Wilks' Lambda	F -Value	DF Coefficient	Significance
Unions	.96	607.87	.52	.00
School prayer	.97	457.72	.44	.00
Nuclear power	.97	462.07	.36	.00
Gay rights	.97	442.59	.26	.00
Death penalty	.97	369.72	.22	.00
Federal housing	.98	255.98	.30	.00
Moral majority	.98	211.94	.20	.00
Women’s liberation	.98	241.72	.18	.00
Socialism	.98	256.28	.16	.00
Busing	.98	237.63	.12	.00
Pacifism	.99	150.19	.17	.00
Capitalism	.99	78.78	.17	.00
Total annual family income	.99	148.91	.11	.00
The draft	.99	174.85	.09	.00
Living together	.99	105.34	.07	.00
Military drill	.99	129.12	.07	.00
Church attendance	.99	131.26	.00	.00
Educational attainment	1.00	65.17	.22	.00
Immigration	1.00	38.52	.13	.00
Divorce	1.00	14.72	.12	.00
Segregation	1.00	8.20	.07	.00
Censorship	1.00	57.93	.07	.00
Property tax	1.00	3.25	.06	.07
X-rated movies	1.00	3.75	.06	.05
Abortion	1.00	50.23	.00	.00
Foreign aid	1.00	1.12	.23	.29
Total N =11970				

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[95] The survey instrument did not specify the definition of Nuclear Power; though intended to measure opinion on nuclear power as an alternative energy source to be used for public consumption, it is very possible it was interpreted as nuclear power being nuclear weapons power. Thus we removed it from the analyses.

The findings in the preliminary and discriminant analyses add support to the use of the Virginia HLQ as similar to the general voting public in the 1980's. The issue differences between the parties in the 1980's as described in the extant literature (Fiorina 1981) are also those identified by the statistical analyses performed on this sample.

One could make an argument to include independents in the analyses, however, while independents make up a large percentage of the sample and voting public, traditional NES reports provide ample evidence that the overwhelming majority of Americans vote Rep or Dem. Based upon the lack of issue differentiation between independents and the two major parties in this sample, we cannot for certain place independents in the middle without imputation.[96]

The phenotypic polychoric correlations by twin pair zygosity are shown in Table 4. Table 5 presents the polychoric correlations between items for females and males. Correlations were higher for MZ pairs than DZ pairs and in most traits higher for males than females. There are some substantial differences in the correlations of opposite sex pairs compared to those for same sex DZ pairs. These results led us to examine several models to explain the sources of variation, including sex limitation models, and nested models that equate the path components for men and women.

Table 5.4: Twin Correlations for Voting, Sociodemographic Traits and Political Attitudes (Party ID - Direction)

	MZF	DZF	MZM	DZM	DZOS
Rep v. Dem	.84	.80	.82	.79	.76
church attendance	.75	.51	.60	.48	.38
school prayer	.66	.47	.65	.45	.42
gay rights	.61	.49	.58	.38	.36
death penalty	.56	.38	.54	.43	.29
unions	.44	.26	.43	.24	.13
federal housing	.43	.26	.25	.23	.15
N Pairs[a]	2029	1273	826	610	1397

Note: (a) Correlations were estimated for full information maximum likelihood observations on incomplete pairs. Due to missingness cases range: MZF(1967-2029), DZF (1223-1273) ,MZM (808-826), DZM (593-610), DZOS (1359-1397).

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[96] Several scholars go so far as to claim that the independents are in fact closet partisans, but due to their claim of "independent" status, they cannot be separated into either Democrat or Republican camps (Keith et al. 1992).

Table 5.5: Polychoric Correlations [a] between Party ID, Attitudes, and Religiosity Covariates; Males Upper Triangle, Females Lower Triangle.

	Males (N = 6920)							
	1	2	3	4	5	6	7	8
1. Rep v. Dem	.	.16	.39	-.39	.46	-.47	-.35	.09
2. church attendance	.15	.	.35	-.26	-.03	-.07	.03	-.20
3. school prayer	.39	.37	.	-.55	.39	-.16	-.19	-.13
4. gay rights	-.34	-.38	-.55	.	-.43	.24	.36	.10
5. death penalty	.32	-.06	.26	-.24	.	-.24	-.31	.01
6. unions	-.41	-.11	-.11	.24	-.18	.	.32	.07
7. federal housing	-.30	-.04	-.20	.34	-.19	.29	.	-.04
8. Age	.03	-.22	-.15	.17	.07	.09	-.02	.
	Females (N = 9563)							

Note: (a) casewise deletions

The Genetics of Party Identification

Univariate models containing additive genetic, common environmental and unique environmental variance components were fitted to determine which model best explains PID correcting for age (Table 6). The results provide no evidence that the Equal Environments Assumption was violated as equating the thresholds for MZ's and DZ's provided a better model fit; thus, using a twin design for this phenotype is appropriate. There were also no significant sex differences in the thresholds. The sex-limitation model containing only common environment and unique environment components (CE) for both females and males was not significantly different (p=.31) than the full sex limitation model (ACE) and provided a more parsimonious fit (2.34 change in chi-square, for 2 degrees of freedom). According to the univariate analyses, a CE model was the best fitting model. There is no significant additive genetic component for PID; common environment accounted for the majority of variance (.81), and unique environment accounted for .19 of the variance. This is an important find for several reasons. First, it appears that Campbell et al. (1960) were correct, and that PID is largely due to familial socialization. Secondly, a majority of the findings in the behavior genetics literature rarely encounter such a strong "C." In fact when first found, as I announced the finding in the lab, I was surprised to find a crowd of post-docs and PhD students gathered around my desk, looking curiously at the idea that socialization was so important![97]

Univariate analyses were also conducted for each of the six attitude item correlates previously identified in the discriminant analyses, and ACE models were fitted to estimate genetic and environmental variance components (Table 7). All item analyses provide no evidence of a violation of the EEA as equating the thresholds for MZ and DZ twin pairs provided a better model fit. Furthermore, the genetic component could not be removed from any item, while the common environment component could be removed from unions and federal housing. However, models containing environmental variances only (CE or E models) fit significantly worse for all items.

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[97] Of course, I encounter the same puzzled reaction in most political scientists when I show that most items have such a large degree of A. It is clear that if anything, these two groups need to talk more.

Table 5.6 Standardized Variance Components Sex Limitation Model Fitting for PID (Rep vs. Dem); Thresholds Corrected for Age - Preferred Model in Bold

	Parameter Estimates (95% CI)									
	Females			Males						
Model	a^2	c^2	e^2	a^2	c^2	e^2	-2LL	ΔX^2	Δdf	p-value (comparison model)
ACE Eq th	.08 (0-.24)	.76 (.61-.86)	.17 (.12-.21)	.12 (0.-30)	.71 (.54-.71)	.18 (.15-.26)	8736.41	0.00	1	.83 (ACE)
ACE (M=F)	.10 (0-.21)	.74 (.63-.82)	.17 (.13-.21)	.10 (0-.21)	.74 (.63-.82)	.17 (.13-.21)	8736.80	0.39	3	.94 (ACE)
AE	.34 (0-.50)	-	.66 (0-.50)	.34 (0-.50)	-	.66 (0-.50)	8862.35	125.55	1	<.001 (ACE)
CE	**-**	**.81 (.78-.84)**	**.19 (.16-.22)**	**-**	**.81 (.78-.84)**	**.19 (.16-.22)**	**8738.75**	**2.34**	**2**	**.31 (ACE)**
E	-	-	1	-	-	1	9700.73	964.31	3	<.001 (ACE)

Table 5.7 . (US) Standardized Variance Components (95% CI) Sex Limitation Model Fitting for Political Attitudes; Thresholds Corrected for Age[a]

		Parameter Estimates									
		Females			Males						
	Model	a^2	c^2	e^2	a^2	c^2	e^2	-2LL	ΔX^2	Δdf	p-value (comparison model)
Religiosity	ACE[bc]	.56 (.35-.66)	.19 (.08-.39)	.25 (.21-.29	.22 (.00-.57)	.36 (.05-.59)	.41 (.32-.50)	15047.54	3.33	3	.34 (ACE)
School Prayer	ACE[b]	.32 (.16-.48)	.37 (.22-.51)	.31 (.27-.36)	.47 (.22-.62)	.21 (.09-.41)	.32 (.26-.40)	18018.47	4.66	4	.32 (ACE)
Gay Rights	ACE[bd]	.34 (.24-.45)	.25 (.22-.34)	.41 (.39-.45)	.34 (.24-.45)	.25 (.22-.34)	.41 (.39-.45)	22434.67	5.02	3	.17 (ACE)
Death Penalty	ACE[bd]	.35 (.22-.48)	.21 (.10-.31)	.44 (.40-.48)	.35 (.22-.48)	.21 (.10-.31)	.44 (.40-.48)	18872.82	0.29	3	.96 (ACE)
Unions	AE[bd]	.41 (.36-.46)	-	.59 (.54-.64)	.41 (.36-.46)	-	.59 (.54-.64)	24884.86	4.34	2	.11 (ACE)
Federal Housing	AE[b]	.41 (.36-.46)	-	.59 (.54-.64)	.41 (.36-.46)	-	.59 (.54-.64)	22455.92	5.49	2	.06 (ACE)

Note: (a) Only best fitting models shown. (b) Equated Thresholds for MZ and DZ pairs (no violation of EEA). (c) Equated Thresholds for Males and Females, MZ and DZ twins. (d) Equated Variance components for Males and Females.

Multivariate analysis

Based upon the univariate findings, PID has no genetic component and was primarily common environmental in origin; however it is unclear where the source of the common environmental variance is coming from. Is it independent to party identification itself or is familial socialization affecting other covariates that in turn affect PID? As mentioned previously in the Methods section and in Chapter 3, Cholesky decomposition can be used to flush out the source of variance.

Several reduced models were compared the saturated Cholesky (Table 8). Removing the entire additive genetic component (A) or common environment component (C) for all items significantly worsened model fit for both males and females. The univariate analyses showed no genetic source of variance for PID, which suggests the model could be further simplified by removing specific genetic paths to PID in the multivariate. Removing the additive genetic path specific to PID did not provide a significantly worse fit and was more parsimonious.

Standardized factor loadings for the reduced Cholesky are shown in Table 9. This measure assumes that the common environmental and unique environmental variation of PID is determined by a component underlying PID as well as all the other variables in the model.

In the reduced model, the remaining C specific to PID (C7) accounted for a majority (55% or $.747^2$) of the common environmental variance. In other words, using the most salient ideological issue positions (attitude items) as covariates accounted for little of the common variance in PID; it appears that party identification is a specific item due to familial socialization and this socialization is directed on PID itself, and not other covariates influencing PID. Utilizing the classical twin design provides evidence that Fiorina's (1981) assumptions that salient issue positions provide the source of party identification does not hold, both by providing evidence that common environment (C) is by far the greatest source of variance (81%) and that this C is specific to PID and not key issue positions.

Table 5.8 Seven-variate Cholesky Decomposition Genetic Model Fitting (PID-Direction)[a]

Model	ΔX^2	Δdf	p-value (comparison model)
ACE	-	-	-
ACE (no a to PID)	**16.54**	**14**	**.28 (ACE)**
AE	646.32	28	<.001 (ACE)
CE	354.00	21	<.001 (ACE)
E	5724.73	49	<.001 (ACE)

Note: (a) Preferred model in bold.

Of significant importance, and similar to the common environmental factor, the final unique environment factor loading on PID was quite strong (.507). After all other unique environmental variance is accounted for by PID's correlates, the unique environment (E) (including measurement error) specific to PID accounts for 25% of E's variance. Keeping in mind, in the univariate analyses E only accounted for 19% of the variance of PID. Thus both common and unique environmental components of the Cholesky decomposition provided a specific influence on PID. These findings imply that a majority of both the unique and common environmental variance in PID is specific to itself, and not related or influenced by its covariates. That is, that people are socialized for one party or another specifically, and that the socialization or personal experiences related to party affiliation are not a byproduct of some other socialization or personal experience factor related to the issue items in the analyses.

However, reviewing these Cholesky results left me dissatisfied. The PID correlates ended up only provided only a weak relationship to PID itself, none the factor loadings of the covariates explained more than 10% of the variance in either the common or unique environment of PID. This prompted me to reconsider the approach using key ideological attitude items. Noting that the univariate results showed PID being a CE model, I considered that a second multivariate analysis was warranted using related covariates that contained a large amount of common environmental or familial socialization variance.

Table 5.9: Cholesky Decomposition Standardized Path Coefficients- Saturated Model (males and Females) – PID

Additive Genetic Factor

	A1	A2	A3	A4	A5	A6	A7
Church	-0.515						
School Prayer	0.024	0.49					
Gay Rights	0.04	-0.133	0.393				
Death Penalty	0.085	0.096	-0.043	0.433			
Unions	-0.022	-0.003	0.11	-0.293	0.409		
Fed Housing	-0.123	-0.166	0.017	-0.149	0.15	0.126	
Party ID	0	0	0	0	0	0	0

Common Environment Factor

	C1	C2	C3	C4	C5	C6	C7
Church	-0.65						
School Prayer	-0.397	0.502					
Gay Rights	0.334	-0.341	0.421				
Death Penalty	0.084	0.23	-0.103	0.51			
Unions	0.083	-0.005	0.057	0.022	0.358		
Fed Housing	0.079	-0.023	0.334	-0.059	0.051	0.338	
Party ID	-0.107	0.146	-0.179	-0.107	-0.316	-0.05	0.747

Unique Environment Factor

	E1	E2	E3	E4	E5	E6	E7
Church	0.524						
School Prayer	0.08	0.582					
Gay Rights	-0.131	-0.147	0.614				
Death Penalty	-0.029	0.102	-0.188	0.643			
Unions	-0.055	0.061	0.124	0.018	0.751		
Fed Housing	-0.06	0.02	0.177	0.002	0.07	0.785	
Party ID	0.001	0.013	-0.052	0.035	-0.07	-0.024	0.507

Based upon what was available in the survey and known to be socialization variables, the following covariates were selected: church attendance, income, education, occupation, and marital status. I also included an ideology index score. Church attendance and income were previously identified, occupation is dichotomous variable (professional or labor), marital status is also a dichotomous variable that combines married with living together versus single, and ideology is an index score calculated from the combined individual items of the Wilson Patterson scale of political attitudes (scoring

1 for conservative, 0 for varies and -1 for liberal). The phenotypic polychoric correlations by twin pair zygosity are shown in Table 10.

Table 5.10: Twin Correlations for Voting, Sociodemographic Traits and Political Attitudes (Party ID)

	MZF	DZF	MZM	DZM	DZOS
1. Rep v. Dem	.84	.80	.82	.79	.76
2. church attendance	.75	.51	.60	.48	.38
3. Education	.88	.71	.86	.63	.57
4. occupation	.69	.51	.63	.41	.15
5. married	.35	.18	.49	.40	.19
6. wealth	.80	.70	.76	.50	.49
7. Ideology	.67	.46	.60	.37	.34
N Pairs[a]	2029	1273	826	610	1397

Note: (a) Correlations were estimated for full information maximum likelihood observations on incomplete pairs. Due to missingness cases range as follows: MZF(1967-2029), DZF (1223-1273) ,MZM (808-826), DZM (593-610), DZOS (1359-1397).

A Second Multivariate analysis

Similar to the initial analyses, using these new covariates several reduced models were compared to the saturated Cholesky (Table 11). Removing the entire additive genetic component (A) or common environment component (C) for all items significantly worsened model fit for both males and females, but again similar to the initial multivariate, removing the additive genetic path specific to PID did not provide a significantly worse fit and was more parsimonious. Standardized factor loadings for the reduced Cholesky are shown in Tables 12 (females) and 13 (males).

Table 5.11: Seven-variate Cholesky Decomposition Genetic Model Fitting (PID – 2nd analyses) [a]

PID SL

Model	AIC	ΔX^2	Δdf	p-value (comparison model)
ACE		-	-	-
ACE (no a to PID)		**6.96**	**14**	**.94 (ACE)**
AE		1849.72	42	<.001 (ACE)
CE		128.79	35	<.001 (ACE)
E		5499.52	63	<.001 (ACE)

Note: (a) Preferred model in bold.

Table 5.12: Cholesky Decomposition Standardized Path Coefficients- Saturated Model (females)

Additive Genetic Factor

	A1	A2	A3	A4	A5	A6	A7
church attendance	-0.723						
Wealth	-0.202	-0.203					
Education	0.213	0.264	0.329				
occupation	0.14	-0.33	0.452	0.121			
married	-0.116	-0.085	0.148	-0.142	0		
Ideology	0.092	0.097	-0.113	0.404	0	0	
PID	0	0	0	0	0	0	0

Common Environment Factor

	C1	C2	C3	C4	C5	C6	C7
church attendance	-0.565						
Wealth	-0.209	0.727					
Education	-0.163	-0.32	0.698				
occupation	-0.127	-0.51	0.297	0.128			
married	0.309	-0.174	0.044	-0.319	-0.017		
Ideology	0.62	0.082	-0.124	0.242	-0.197	0.167	
PID	-0.296	0.014	-0.252	-0.19	0.201	-0.689	0.34

Unique Environment Factor

	E1	E2	E3	E4	E5	E6	E7
church attendance	0.384						
Wealth	0.092	0.194					
Education	-0.018	0.027	0.362				
occupation	0.095	0.184	0.264	0.392			
married	-0.029	0.072	-0.04	-0.205	0.807		
Ideology	0.019	-0.23	-0.014	0.006	0.16	0.435	
PID	-0.09	0.149	0.007	-0.052	-0.035	-0.152	0.299

In the reduced model, the remaining C specific to PID (C7) was remarkably different than the initial multivariate that only included key issue positions; the residual (c) in this second analysis only accounted for 12% and 6% of the common environmental variance in females and males respectively versus the greater than 50% in the initial analyses. Political attitudes (the ideological issue position index score from the WP scale) accounted for a majority of the common environmental variance; 47% and 64% in females and males respectively. Hence, while individually key attitudes are not informative and account for little of the common environmental variance in PID (as shown in the initial multivariate), when considered on the whole, issue positions potentially explain the majority of common environmental variance in PID. Church attendance was the only socialization item that accounted for a relevant amount of the C variance, but no where near the ideology issue position index score. In this model, party identification may not be a specific item subject to familial socialization itself, but could be largely a result of socialization on the summation of all political attitudes. In essence the relationship between PID and political attitudes is multifaceted and dynamic.

Table 5.13: Cholesky Decomposition Standardized Path Coefficients-(males)

Additive Genetic Factor

	A1	A2	A3	A4	A5	A6	A7
church attendance	-0.553						
Wealth	0.272	-0.191					
Education	0.064	-0.056	0.647				
occupation	0.064	0.039	0.461	0			
married	0.279	0.071	0.026	0	0		
Ideology	0.154	-0.467	-0.242	0	0	0	
PID	0	0	0	0	0	0	0

Common Environment Factor

	C1	C2	C3	C4	C5	C6	C7
church attendance	-0.542						
Wealth	-0.396	0.632					
Education	-0.125	-0.2	0.652				
occupation	0.041	-0.168	0.46	-0.286			
married	0.048	-0.181	0.004	-0.296	-0.507		
Ideology	0.4	-0.065	-0.209	0.037	-0.105	0.4	
PID	-0.303	-0.008	-0.221	-0.085	0.04	-0.805	0.245

Unique Environment Factor

	E1	E2	E3	E4	E5	E6	E7
church attendance	0.628						
Wealth	0.259	0.387					
Education	-0.113	-0.16	0.276				
occupation	-0.074	-0.138	0.182	0.603			
married	-0.085	0.228	0.247	-0.198	0.572		
Ideology	-0.078	-0.418	-0.145	0.057	0.248	0.233	
PID	0.053	0.14	0.074	-0.177	-0.287	0.105	0

Therefore the question remains: does PID socialization drive political attitudes, or does the C component of political attitudes drive the C component and majority of variance in PID akin to what Fiorina suggests? Although Fiorina does not specifically mention the common or unique environmental sources of variance, the concept is the same. In either event the C component of PID and the combined score of all issue positions are highly related and may be measuring the same construct. While not analyzed here, a potential means to solve this dilemma is to develop a direction of causation model - to find out if there is a causal relationship or if it's dynamic. Thus while the multivariate cholesky is useful to rule out only salient political issues as driving Party ID, more complex models are required to separate PID from the combination of all political attitudes.

Strength of Partisanship

Equally important to clarifying the source of the direction of partisanship, is the lack of understanding of the strength of partisanship. Based upon previous findings which examined religiosity and religion and the findings above that verify PID is primary due to common environmental forces, I suspect the same pattern applies with strength of identification vs. religiosity. As such my second hypothesis is that strength of party identification is primarily genetic, similar to religiosity.

Methods

Sample and Measures

The data are the same as utilized for party identification. The primary phenotype of Strength of Party Identification is assessed by the questionnaire item: "Political Affiliation." Under this heading respondents were asked "Under each topic below write in the number which best describes [your] education, occupation, etc: (1) Don't know (2) Always supports Republicans (3) Usually supports Republicans (4) Varies (5) Usually supports Democrats (6) Always supports Democrats (7) Other (8) Prefer not to Answer. Twins were asked to report for "You, Your Twin, Your mother, Your father, Your spouse". For Strength of PID "Usually" and "Varies" (3 to 5) were combined to create weak or no partisanship, and “Always” (2 and 6) were combined to create strong partisanship, thus creating a dichotomous variable of Strong versus Weak.[98]

Results

Univariate Analyses

The univariate results confirm the hypotheses that Strength of Partisanship is a different construct than partisanship alone and that this form of political intensity is highly genetic, whereas direction of partisanship is primarily environmental (see Table 14). Utilizing the same methodology and model fitting as in the PID analyses, the best fitting model for strength of party identification is an AE model (additive genetic and unique environment, but no common environment) where 50% of the variance in Strength of PID is determined by ones genes and 50% by personal experience, but no significant amount by familial socialization.

However, similar to other univariate analyses, the results do not identify if this genetic variance is specific to strength in partisanship alone, or if we are merely measuring another construct that is expressed through strength of partisanship. Is there an intensity gene that is expressed though items like religiosity, group affiliation, loyalty or personality traits?

So why are some people more partisan than others? Strength of partisanship is a measure of political intensity. As such, the underlying construct I am attempting to isolative may be intensity in general or may be a specific political intensity. There is a vast literature examining personality traits that address group affiliation and intensity (McClosky 1958; Eysenck and Eysenck 1985; Eysenck 1990; Eysenck 1991; Eysenck 1992a, 1992c; Zuckerman 1994; Revelle 1997; Caprara and Cervone 2000). As such, attempting to link personality to strength of partisanship provides an ideal starting place to further explore the strength of party affiliation. Unlike religion, or which party one identifies with, personality measures do not contain a significant shared environment component, again making personality ideal for a multivariate design with PID Strength as

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[98] Creating a 3 point version of Strength of Partisanship that separated varies into its own category, was more normally distributed, but provided minimal difference in results but reduced power. Thus we used the format that gave us the most power combining weak with varies.

it is also and AE construct (Tellegen et al. 1988; Pedersen et al. 1988; Bouchard et al., 1990; Eaves, et al., 1989). However, an examination of the literature also shows that religiosity and personality have a genetic relationship (Eaves et al. 1999; Truett et al. 1992). Thus personality along with religiosity (church or religions service attendance) appear to be ideal candidates for a multivariate examination to explore the source of variance in strength of party identification.

Table 5.14 Standardized Variance Components (95% CI) Sex Limitation Model Fitting for Strength of Partisanship Thresholds Corrected for Age[a]

	Parameter Estimates									
	Females			Males						
Model	a^2	c^2	e^2	a^2	C^2	e^2	-2LL	ΔX^2	Δdf	p-value (comparison model)
ACE (M=F)	.34 (.31-.53)	.14 (0-.27)	.52 (.52-.59)	.34 (.31-.53)	.14 (0-.27)	.52 (.52-.59)	10755.78	5.54	3	.14 (ACE)
AE	**.50 (.44-.50)**	**-**	**.50 (.44-.54)**	**.50 (.44-.50)**	**-**	**.50 (.44-.54)**	**10758.86**	**3.08**	**1**	**.08 (ACE)**
CE	-	.39 (0-.39)	.61 (.25-.61)	-	.39 (0-.39)	.61 (.25-.61)	10768.39	12.61	2	<.001 (ACE)
E	-	-	1	-	-	1	13809.33	3053.55	3	<.001 (ACE)

Note: (a) Preferred model in bold

Personality

Early research on personality and politics mainly explored individual differences in the dispositions, attitudes, and motives of voters and elites. Scholars developed constructs such as conservatism (McClosky 1958), alienation (Seeman 1959), dogmatism (Rokeach 1960), authoritarianism (Sanford 1973), and power (Winter 1988).[99]

Numerous studies find relationships between personality and political ideology, with the “Openness to Experience” dimension of the Five-Factor Model being the most prominent. In converging evidence, there is a significant negative correlation between openness and right-wing conservatism (van Hiel et al. 2000). Furthermore, Butler (2000) finds that authoritarianism, the tendency to be hierarchical, conventional, and intolerant, is as an extreme feature of general right wing ideology and is also linked to low openness to new experiences.[100]

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[99] See Caprara et al 2006 for a review of the literature.

[100] Van Hiel et al (2004) investigated the relationship between right wing ideology and maladaptive personality and not only finds that openness to experience was significantly related to right wing ideology, but Compulsiveness and Disagreeableness were also significantly related to right wing ideology compared to other personality traits being only modestly related to political ideology. Furthermore, people with high authoritarianism scorers on the F-Scale have less love for animals and people and have a more rightist

One of the most referenced personality measurements is Eysenck's PEN paradigm of personality psychology. There are three main factors: Psychoticism (versus impulse control), Extraversion (vs. introversion), and Neuroticism (emotional stability versus instability); and subfactors of social conformity and impulsivity (Eysenck and Eysenck 1985).[101]

Gray (1981) modified Eysenck's original theory by adjusting the dimensions of extraversion and neuroticism and developing two new dimensions: impulsivity (high on neuroticism and extraversion) and anxiety (high on neuroticism, low on extraversion). While there continues to be substantial debate regarding the number of dimensions that define personality (Gray 1981; Eysenck 1991, 1992b, 1992c; Costa and McCrae 1992), the overall concept is generally accepted, and while the debate is worthwhile, it is not necessary to address in these analyses. As the main three Eysenck personality scales are available in the current sample, as well as Impulsivity and the subscale of Social Conformity (Lie scale), these analyses utilize all 5 scales in conjunction with strength of party identification.

While there is continued debate on exactly what personality means, a review of the literature shows that researchers view it as a dynamic combination of life events, personal adaptations and biological mechanisms (Caprara and Cervone 2000). Personality

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political orientation. In 2003 Jost et al. published an extensive meta-analytical review of the literature pertaining to political ideology and personality. In their analysis they discovered nine psychological characteristics are correlated to political conservatism: fear of death, system instability, dogmatism and intolerance of ambiguity, openness to experience, tolerance of uncertainty, personal needs to achieve order, structure and closure, integrative complexity, fear of threat and loss, and self-esteem. Combining these findings with Van Hiel and Mervielde's (2003) finding that there are significant positive correlations between cognitive complexity and extremist ideology and Jost et al's (2003) empirically tested model that shows political conservatism uniquely serves epistemic, existential, and ideological needs driven by fears and uncertainties, we are faced with a portion of the public who is cognitively complex, potentially indifferent to animals and people, has authoritarian personality traits, is compulsive and disagreeable, with ideologues driven by fear? A frightening prospect if representative of the general public. Most importantly, these findings describe many elements of our population with much more clarity than tradition rational actor models. However, conflicting evidence by Crowson et al (2005) indicated that conservatism is not synonymous with right wing Authoritarianism and more than personality affects ideology. Individual religious beliefs are conceptualized as a component of personal ideology, which is one's value-laden philosophy of how life should be lived (de St. Aubin 1999).

[101] Many scholars also advocate the Five Factor Model (FFM) of personality: emotional stability or neuroticism, extraversion or energy, agreeableness or friendliness, conscientiousness, and openness to experience or intellect/culture (Digman 1990; McCrae and John 1992; Caprara et al 1999).

scales are measures of internal mechanisms which are directing affective, cognitive, and motivational processes providing consistency and continuity in behavior and creating a personal identity (Mischel and Shoda 1998; Caprara and Cervone 2000; Bandura 2001).

According to Eysenck, personality dimensions are based on "…genetic, or inborn factors…discovered in the physiological, neurological, and biochemical structure of the individual" (Eysenck and Eysenck 1985:42-43). It is important to understand that personality scales are not a discrete measure, rather each individual can have some degree and any combination thereof on all of the personality continuums (Eysenck 1992a). In addition, empirical evidence has also shown that the three dimensions of personality (psychoticism, extraversion, and neuroticism) are also those found in different nations and cultures (Eysenck and Eysenck 1985; Eysenck 1991).

Extraversion: Extraversion is related to social interest and positive affect and includes: activity, sociability, expressiveness, assertiveness, ambition, dogmatism and aggressiveness. On this continuum, a person with high extraversion is popular, sociable, outgoing, optimistic, but unreliable; a person with low extraversion is introspective, quiet, reserved, but reliable. Extraversion has two central components: interpersonal engagement consisting of affiliation (valuing close interpersonal bonds, being warm and affectionate) and agency (socially dominance, leadership roles, assertive, exhibitionistic and accomplishing goals) (Depue and Collins 1999).[102]

Neuroticism: Neuroticism is related to inferiority, unhappiness, anxiety, dependence, hypochondria, guilt and obsessiveness. A person with high neuroticism is anxious, worried, moody, and unstable, whereas a person with low neuroticism is calm, even-tempered, carefree, and emotionally stable. [103]

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[102] According to Eysenck (1990), extraversion is based on cortical arousal which stimulates the cerebral cortex. This arousal can be measured by skin conductance (Galvanic skin response for instance) or brain waves (FMRI). Extroverts are persistently under aroused and bored while introverts are continually over aroused and edgy. Some researchers posit that Dopamine responsivity, which makes people highly sensitive to incentives may be the underlying factor accountable for extraversion.

[103] Neuroticism is based on activation thresholds in the sympathetic nervous system or the limbic system (hippocampus, amygdala, septum, and hypothalamus) which regulate such emotional states as sex, fear, aggression and the fight-or-flight response (Eysenck and Eysenck 1985; Eysenck 1990). This activity can be measured by heart rate, blood pressure, clammy hands, sweating, and tension in the forehead. Those with high neuroticism experience a fight-or-flight response in the face of minor stressors, while those with

Psychoticism: Psychoticism is associated with risk-taking, impulsivity, irresponsibility, manipulativeness, sensation-seeking, tough-mindedness and practicality. A person with high psychoticism is troublesome, uncooperative, hostile, and socially withdrawn, whereas a person with low psychoticism is altruistic, socialized, empathic, and conventional (Eysenck and Eysenck 1985). Psychoticism correlates highly with magical ideation and is one of the best predictors of religious fervor and how much people will accept extreme beliefs.[104]

Impulsivity: Impulsivity originated as a subfactor of Eysenck's Extraversion but was separated out later as more recent evidence indicated that impulsivity and extraversion were separate traits (Revelle 1997).[105] Impulsivity is best characterized by venturesomeness, low anxiety, low inhibition of impulsive behavior, sensation seeking, risk-taking, novelty seeking, boldness, adventuresomeness, boredom susceptibility, unreliability, and unorderliness (Moeller et al. 2001).

Social Desirability or Lie Scale: Social Desirability or the "Lie" scale dimensions are often characterized with a two-fold nature; 1) as social acquiescence or conformity or 2) lack of self insight (Francis et al. 1991). More recent studies suggest that the first component is concerned with the image of being well behaved and socially conforming, while the second component is more concerned with those desirable but unlikely behaviors or those undesirable but likely behaviors (Pearson and Francis 1989).

Hypotheses

Based on what we know of personality, several of the scales should have a significant relationship with strength of PID, if strength of PID has the same component of intensity as religiosity. Extraversion's affiliation and agency aspects, along with dogmatism make it an ideal candidate for Strength of PID and thus should have a high factor loading in the Cholesky. Neuroticism's only component that seems to match with

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low neuroticism (emotionally stable) experience a fight-or-flight response only when faced with major stressors.

[104] According to Eysenck (1990), psychoticism also has a biological explanation; people who exhibit a psychotic episode have increased testosterone levels and low monoamine oxydase levels (Eysenck 1992b).

[105] Most models of personality separate impulsivity into distinct traits (Zuckerman et al. 1991; Zuckerman 1994).

political intensity is obsessiveness, but this would require obsession with politics specifically, which Neuroticism does not measure; thus Neuroticism should account for little of the variance in Strength of PID (unless the majority of the sample are obsessed with politics). Impulsivity appears to run counter to consistent party identification thus should account for little of the variance, and social desirability or lie scale would depend heavily the environment of the individual, thus also should have a very low loading on Strength of PID. The most intriguing scale is psychoticism. Psychoticism's relationship to magical ideation and religious fervor appear to make it an ideal candidate to explain political intensity, if the intensity element in Strength of PID is the same element in religious intensity. Thus my overall hypothesis is that psychoticism and extraversion should account for a significant portion of the genetic variance in strength of identification.

Preliminary analyses

Table 15 provides the demographic information separated by strength of identification. There were only marginal differences (<3%) in partisan support by age when comparing strong versus weak partisans but a 10 year mean difference in those who had no affiliation at all. However there is a significant difference in educational levels. More weak partisans and those with no affiliation (8 and 6% greater respectively) have at least some college, compared to strong partisans. As such, more non affiliated and weak partisans (5%) were considered middle income or better compared to strong partisans. There remained only marginal differences in which religion one chooses based on Strength of PID, and both strong and weak partisans had almost identical levels of church attendance.

The phenotypic polychoric correlations by twin pair zygosity are shown in Table 16. Table 17 presents the polychoric correlations between items for females and males. Correlations were higher for MZ pairs than DZ pairs and in most traits higher for males than females. There are some substantial differences in the correlations of opposite sex pairs compared to those for same sex DZ pairs. These results led us to examine several models to explain the sources of variation, including univariate sex limitation models, and nested models that equate the path components for men and women.

Table 5.15: Distribution of Age, Education, Income, Religious Denomination and Church Attendance by Strength of PID (%)

	Strong Affiliation	Weak Affiliation	No Affiliation
Age			
Mean	56	54	46
SD	19	18	17
Sex			
Male	35	37	37
Female	65	63	63
Education			
< 7 years	1.86	.95	.78
8 years	3.95	3.01	1.66
9-11 years	9.73	7.72	7.90
High School Diploma	34.60	30.51	34.45
College (1-3 years)	26.35	25.55	26.95
College graduate	23.50	32.25	28.26
Income			
< 5000	2.98	2.25	1.66
<10000	5.74	4.14	3.94
<15000	9.49	8.07	7.71
<20000	10.21	9.63	9.46
<25000	11.48	10.43	11.30
<35000	19.15	19.15	20.70
<50000	18.65	20.83	23.01
>50000	22.30	25.50	22.22
Religious denomination			
Catholic	14.65	15.78	15.45
Protestant	69.37	68.00	64.34
Jewish	2.99	4.73	3.54
Other	10.26	8.01	13.03
None	2.73	3.48	3.65
Church attendance			
2+ per Week	17.31	16.70	14.33
Weekly	31.11	31.55	27.73
Monthly	10.27	10.69	11.24
Yearly	16.70	16.44	18.46
Rarely	17.57	18.31	21.13
Never	7.04	6.33	7.11
N	10772	9443	6777

Table 5.16: Twin Correlations for Voting, Sociodemographic Traits and Political Attitudes (Strength of Party ID)

	MZF	DZF	MZM	DZM	DZOS
PID STR	.48	.41	.48	.24	.24
church attendance	.75	.51	.60	.48	.38
EPQ Neuroticism	.41	.25	.38	.14	.12
EPQ Lie Scale	.54	.32	.44	.31	.25
EPQ Extraversion	.51	.11	.46	.16	.12
EPQ Impulsivity	.31	.11	.31	.19	.10
EPQ Psychoticism	.35	.13	.30	.18	.13
N Pairs[a]	2029	1273	826	610	1397

Note: (a) Correlations were estimated for full information maximum likelihood observations on incomplete pairs. Due to missingness cases range as follows: MZF(1774-2012), DZF (1054-1253) ,MZM (745-824), DZM (527-607), DZOS (1219-1394).

Table 5.17: Polychoric Correlations[a] between Strength in Party ID, Religiosity and Personality Subscales; Males Upper Triangle, Females Lower Triangle.

	Males (N = 5325)							
	1	2	3	4	5	6	7	8
1. PID STR	.	.19	.08	.05	.05	.07	.11	-.15
2. church attendance	.18	.	.11	.05	.05	.10	.11	-.11
3. EPQ Neuroticism	.09	.07	.	.08	.14	.32	.18	-.07
4. EPQ Lie Scale	.02	.05	.04	.	.30	.13	.33	.14
5. EPQ Extraversion	.03	.05	.05	.33	.	.36	.31	-.02
6. EPQ Impulsivity	.05	.04	.21	.15	.35	.	.27	-.07
7. EPQ Psychoticism	.08	.09	.13	.34	.34	.24	.	-.04
8. Age	-.16	-.07	-.11	.24	.06	.01	-.05	.
	Females (N = 9436)							

Note: (a) casewise deletions

Multivariate Results

Table 18 provides the model fitting results. The best fitting model is a reduced ACE model, which removes common environment from Strength of Party Identification only. Several reduced models were compared the saturated Cholesky (Table 18). Removing the entire additive genetic component (A) or common environment component (C) for all items significantly worsened model fit for both males and females. The univariate analyses showed no common environmental source of variance for Strength of PID, which suggests the model could be further simplified by removing specific common environmental paths to Strength of PID in the multivariate. Removing the common environmental genetic path specific to Strength of PID did not provide a significantly worse fit and was more parsimonious.

Table 5.18: Seven-variate Cholesky Decomposition Genetic Model Fitting for Strength of PID (Males and Females Analyzed Separately)[a]

PID STR

Model	ΔX^2	Δdf	p-value (comparison model)
ACE	-	-	-
ACE (NO C on STR)	18.99	14	.17 (ACE)
AE	71.88	21	<.001 (ACE)
CE	584.64	28	<.001 (ACE)
E	3174.78	49	<.001 (ACE)

Note: (a) Preferred model in bold.

Standardized factor loadings for the reduced Cholesky are shown in Tables 19 (females) and 20 (males). This measure assumes that the genetic and unique environmental variation of Strength of PID is determined by a component underlying Strength of PID as well as all the other variables in the model.

In the reduced model, the remaining A specific to Strength of PID (A7) accounted for 27% and 26% ($.516^2$ and $.467^2$) of the additive genetic variance in females and males respectively, and roughly 70% of the unique environmental variance. In other words, by using personality measures as covariates, it appears that strength of party identification is a specific construct not measured by other genetic intensity scales. In fact, the strongest loading outside of the residual variance due to Strength of PID itself was extraversion in males that only accounted for a paltry 2% of the genetic variance.

Table 5.19 Cholesky Decomposition Standardized Path Coefficients- Saturated Model (Females) - Strength of PID

Additive Genetic Factor

	A1	A2	A3	A4	A5	A6	A7
church attendance	-.668						
EPQ Neuroticism	.002	-.675					
EPQ Lie Scale	-.003	.140	.576				
EPQ Extraversion	.042	.021	-.274	.558			
EPQ Impulsivity	-.103	-.062	.080	-.059	.515		
EPQ Psychoticism	-.015	-.289	.128	-.066	.121	-.371	
PID STR	.006	.028	-.040	-.134	-.040	-.026	.516

Common Environment Factor

	C1	C2	C3	C4	C5	C6	C7
church attendance	.252						
EPQ Neuroticism	.047	-.110					
EPQ Lie Scale	.141	.095	.253				
EPQ Extraversion	-.115	.010	.227	.190			
EPQ Impulsivity	-.002	.077	-.035	.020	-.022		
EPQ Psychoticism	.068	-.085	-.004	.008	.114	.000	
PID STR	.000	.000	.000	.000	.000	.000	.000

Unique Environment Factor

	E1	E2	E3	E4	E5	E6	E7
church attendance	.665						
EPQ Neuroticism	-.033	.720					
EPQ Lie Scale	.007	-.161	-.758				
EPQ Extraversion	.008	.004	.111	-.667			
EPQ Impulsivity	.044	.021	-.062	.056	-.734		
EPQ Psychoticism	-.012	.241	-.073	.107	-.083	-.782	
PID STR	-.008	-.015	.008	.007	.026	.034	-.832

Thus, the results in these analyses do not confirm the hypotheses presented. None of the major or minor personality scales appeared to have much influence on the genetic source of variance in strength of party identification. A majority of the genetic variance in strength of identification remains specific to itself, suggesting that partisan strength or intensity is a unique construct not related to religiosity or personality. This leaves many questions yet to be answered. Where does strength of partisanship come from? Is this a truly separate process in the brain or do certain hormones effect political intensity and not intensity in general, or both? Is political intensity, or political group support different than other types of intensity or group support? While these analyses can only begin to answer those questions, it does for certain separate personality and religiosity from strength of political affiliation.

These analyses have one important limitation. The use of "Usually" in the question used to assess PID and its translation into weak partisan may be underestimating the difference between strong and weak partisans. An additional option such as "sometimes", or "occasionally" would better fit a weak partisan, thus by no intent of my own, this analyses erred on the side of caution.

Table 5.20: Cholesky Decomposition Standardized Path Coefficients- Saturated Model (males) - Strength of PID

Additive Genetic Factor

	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**
church attendance	-.432						
EPQ Neuroticism	-.030	-.563					
EPQ Lie Scale	-.307	.084	.456				
EPQ Extraversion	-.070	-.126	-.098	.263			
EPQ Impulsivity	.036	.006	.104	.276	.325		
EPQ Psychoticism	-.068	-.209	.131	.153	.199	-.210	
PID STR	-.020	.076	-.074	-.144	-.050	-.052	.467

Common Environment

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
church attendance	.476						
EPQ Neuroticism	-.023	.302					
EPQ Lie Scale	-.223	-.010	-.118				
EPQ Extraversion	-.218	-.287	.368	.200			
EPQ Impulsivity	.275	.032	-.209	.097	-.197		
EPQ Psychoticism	.103	.184	-.081	-.234	.107	.000	
PID STR	.000	.000	.000	.000	.000	.000	.000

Unique Environment Factor

	E1	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**
church attendance	.763						
EPQ Neuroticism	-.023	.781					
EPQ Lie Scale	.012	-.162	.700				
EPQ Extraversion	.009	-.017	-.166	.747			
EPQ Impulsivity	.037	-.031	.073	-.126	-.898		
EPQ Psychoticism	-.006	.253	.106	-.128	-.112	-.770	
PID STR	-.019	-.027	-.013	-.045	-.003	.026	-.840

Vote Choice[106]

Traditional Vote Choice Theories

Traditional vote choice theories make important assumptions regarding voting behavior that differ from typical assumptions made by behavior geneticists, thus requiring some explanation. Emil Durkheim (1895) claimed social behaviors could only be explained by social indicators. This view continues to persist today among political scientists. The overwhelming majority of political science research adheres to the standard social science model, attributing 100 percent of behavior differences to socialization factors or reactions to external stimuli (Corning 1971; Tooby and Cosmides 1992). In the political science literature there are two overarching theories of vote choice; one centered on psychological attachments to parties and socio-political groups (Campbell et al. 1960) and the second centered on rational choice or economic voting (Downs 1957; Popkin 1991).

Examining voters' decisions from a socio-psychological perspective, the "Michigan School" found that voters relied more on stable political party identification and partisan attitudes, minimizing the vote choice effects of specific elections (Campbell et al. 1960). A significant part of the Michigan approach is the idea that vote choice is largely attributed to familial socialization factors (Campbell et al. 1960; Page and Jones 1979; Carmines and Stimson 1980). From a socio-psychological view, vote choice is a function of common environment, and minimal unique environment, but allows no room for genetic influences.

The alternative and increasingly dominant vote choice model in political science rests on the assumption of a "rational" voter (Popkin 1991). Accordingly, emergent social phenomena such as voting behaviors are ultimately the result of rational choices made by self-interested utility-maximizing individuals (Lichbach 2003). Preferences (attitudes) are given; they are a "black box" and the sources of political attitudes are irrelevant. Political action, such as voting, is nothing more than revealed preferences and voting decisions are based upon reactions to external stimuli, or unique environment

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[106] Portions of this chapter are published in Hatemi et al (2007).

(Tooby and Cosmides 1992; Alford et al. 2005). Though it is not explicitly stated, nor ever utilized in the social science literature, following the logic of rational choice does allow for the possibility of genetic sources through its "black box" approach to the source of preferences. However, there is one important caveat; rational choice adheres to the concept that expressed actions are derived from rational cognition, implying that a person must know their attitudes in order to engage in utility maximization. Thus, in behavior genetics terms, rational vote choice is a function of unique environment plus the explicit potential of common environment, and the implicit possibility of genetic effects.

Numerous studies offer significant challenges to both models' validity. Indeed, empirical evidence from political psychology suggests that voters are highly and often unwittingly receptive to framing effects; moreover, studies of mass public opinion suggest that political behavior is relatively inconsistent and voters use "considerations" that vary according to the context of the specific election (Zaller 1992). Thus, counter to the socio-psychological approach, unique environment is of the highest importance, as context matters (Druckman 2001; Nelson 2004). Contrary to the Michigan approach, rational choice promotes the importance of unique environment, and has shown to be a useful model to explain the cognitive portions of human evaluation, but it is also heavily criticized. Studies have shown that perceived threats of policy change are considerably more powerful vote choice motivators than perceived opportunities for policy change; thus suggesting affective motivations, not rational cognitions drive political behavior (Miller and Krosnick 2004). Important in this dialogue is what has been labeled "hard" or "easy" issues (Carmines and Stimson 1980). "Hard" issues, such as water policy, require cognitive evaluation, whereas certain "easy" issues, such as the death penalty and gay marriage, trigger a "gut" response which illicit instant and strong opinions with negligible evaluation. Though not explicitly stated in the social science literature, these "gut" reactions are what have been stated in evolutionary based research to be an expression of adaptive traits, thus heritable in nature (Darwin 1859; Bruell 1970; Wilson 1998; Alexander 2004).

In short, both major vote choice paradigms assume the environment as the only source of preferences, but differ greatly on the emphasis of either common or unique environment. Furthermore, both major theories as well as all secondary theories in the political science literature ignore the potential for biological explanations of political preferences (for more on the primacy of the environment see Merelman 1986; Sears 1989; Landemore 2004; Alford et al. 2005). Thus, the aim of the current analyses is to incorporate ideas from the field of behavior genetics into political science to determine the extent to which either genetic or environmental factors, or both, influence the most fundamental of mass political behaviors (voting), and to examine the validity of both major political science theories from a behavior genetics perspective.

Australian Political Parties in 1988-1990

This examination analyzes self reports of vote choice gathered in surveys of Australian twins contacted in 1988-1990.[107] As this is the first genetics study examining vote choice, and not all readers will be familiar with Australian politics in 1990, some explanation of Australia's political system is warranted. The Australian political system is typically characterized as a two and a half party system. In general, the Australian Labor Party (Labor) competes nationally with the Liberal and National parties in coalition (Conservatives) (Moon and Sharman 2003). Both coalition parties are right of center in orientation but the Liberals have a more urban base, while the National Party has a mainly rural base. At the time of the survey Labor was in power at the federal level and had held control since 1983. While Labor was able to maintain control of government for six more years (1996), the 1990 election witnessed a swing to the Conservatives as Australia was faced with high interest rates and an economic downturn. The results of the elections saw the Conservatives win over 43% of the vote, gaining 8 seats in the House of Representatives, compared to Labor's 39% and loss of 5 seats (Ward 1990). The most significant minor party at the time, the Australian Democratic Party (Democrats), had never competed against the major parties for control of government, but held the balance of power in the Senate (Simms 1996). During the

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[107] US surveys only collected party affiliation and not vote choice specifically.

1988-1990 period the Democrats reached their electoral peak in terms of overall voter percentage in federal elections (over 11%). Since 1990 support for the Democrats has eroded to less than 3% and their voters have defected to the Conservatives and the Greens in equal numbers, but almost none to Labor (Grattan 2000).

Regarding the Labor and Conservative parties, by 1990 competing party leaders shared similar social-demographic backgrounds and the Labor Party had become more middle-class, resulting in less social differentiation from the Conservatives (Jaensch 1989). Even so, there remains a strong identification difference between those who claim partisanship to either party. This difference is seen clearly in key issues positions such as social welfare, organized labor and health coverage (Jaensch 1989; Grattan 2000). Due to these issue differences, the parties remain diametrically opposed in both elite discourse and in the views held by the mass public (Warhurst 1997).

Methods

Sample

Data were collected in the course of mailed surveys of two large cohorts of adult Australian twins born 1902-1972 conducted in 1988-90. The first was a follow-up survey of twins enrolled on the volunteer Australian Twin Registry born 1893-1964 originally surveyed from 1980-82 (Martin et al. 1986). The sample consisted of 7616 twin men and women aged 18-88 years. A total of 3808 twin pairs responded to that study in which, *inter alia,* twins were asked to complete a 50 item modified version of the Wilson-Patterson Social Attitudes Inventory (Martin et al. 1987; Eaves et al. 1989; Truett et al. 1992). In 1988-90 a follow-up survey of this cohort was conducted, attempting to mail all individuals who had responded to the first survey. This Health and Lifestyle Questionnaire (HLQ) contained items on voting preference, social attitudes and a variety of socio-demographic variables. After mail and telephone follow-ups, questionnaires were returned by 6327 individuals (83.1%) including 2995 complete pairs (78.7%). Excluding people who had died or were too sick to participate (217 individuals) or with whom contact could no longer be made (270 individuals), return rates for those who received and were able to return the 1988 questionnaire were 88.8% individually and 85.6% pairwise (Baker et al. 1996).

The second study, 1988-90, attempted to survey by mailed questionnaire all twins enrolled on the Australian Twin Registry who had turned 18 since the first survey (i.e. birth years 1964-1972). The HLQ, which was similar to that sent to the older cohort, was mailed to 4269 pairs. Most of these twins had been recruited while attending primary school some ten years earlier, so despite extensive follow-up investigators were unable to re-establish contact with (exactly) 1000 pairs. Those who failed to return a questionnaire were contacted by telephone up to five times at which point they were asked to complete an abbreviated telephone interview to obtain basic demographic information. Both members of 2294 pairs (70% of contactable pairs) completed a questionnaire or abbreviated phone interview, plus a further 474 single twins, making an individual cooperation rate of 84% of those with whom contact was established. Combining both studies 11,376 questionnaire responses (5289 complete pairs) in which the voting preference item was asked were received, and of these 9,053 individuals responded. The same items were used in both HLQ surveys. However, a limited number of respondents in the AL2 cohort received abbreviated telephone questionnaires where certain socio-political questions were not included.

Comparisons with the Australian Bureau of Statistics provide evidence that these groups are representative of the population in general with regard to education, socioeconomic status and social behaviors, as reported in earlier studies (Jardine and Martin 1984; Kendler et al. 1995; Baker et al. 1996; Heath et al. 1997; Whitfield et al. 2005). Median age at participation of both cohorts combined was 34 years.

Zygosity

Zygosity was determined by two self report items. This method has been shown to provide probably better than 95% agreement with blood typing (Martin and Martin 1975). In addition, blood group and microsatellite marker information has been used to supplement the respondent self reports (Whitfield et al. 2004).

Measures

The primary phenotype of vote choice is assessed by the questionnaire item: "**VOTING PREFERENCE.**" Under this heading twins were asked "Generally speaking, in federal politics do the following people usually think of themselves as: (1) Liberal Party, (2) Labor Party, (3) National Party (4) Australian Democrat (5) Other (6) None of Your Business?". Twins were asked to report for "You, Your Twin, Your mother, Your father, Your spouse". Only self-reports are analyzed here. Based upon the nature of Australian politics at the time of the survey as discussed above, for all analyses the Liberal and National party voters were combined into a single "Conservative" category and all analyses were performed utilizing a dichotomous variable of either voting for Conservatives or Labor. Respondents who responded in the "Other" and "None of Your Business" categories (10%) were set to missing.

In addition to voting, a number of other sociodemographic variables and political attitudes potentially related to vote choice were analyzed. Traditional sociodemographic voting correlates including age, education, social class, religion and church attendance (Campbell et al. 1960; Popkin 1991) were assessed in both cohorts (Table I). Date of birth, originally a continuous variable, was used to divide the respondents into seven age groups (Sapiro et al. 2006) routinely used for vote choice studies in the political science literature (18-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75+).

Political attitudes were assessed utilizing a modified version of the 50-item attitude checklist used to construct the Wilson-Patterson (1968) Conservatism Scale, which includes contemporary social issues of the time. Respondents indicated if they agreed (1), disagreed (3), or were uncertain (2) about their attitudes towards these different issues (Posner et al. 1996).

Preliminary Analyses

Phenotypic frequencies and descriptive statistics using raw data were calculated using SPSS 13 (SPSS Inc. 2004). In order to distinguish which political traits best correlate with voting behavior, discriminant function analyses was performed using all 50 items from the revised Wilson-Patterson Conservatism scale. The smaller the Wilks's lambda, the more important the independent variable is to the discriminant function. The standardized discriminant function coefficients serve the same purpose as beta weights in multiple regression and indicate the relative importance of the independent variable in predicting the dependent (vote choice). Using these two measures the best predictors for voting behavior were selected. Two separate discriminant analyses were used to identify which items best distinguished Conservative from Labor voters, and Democrat from both Labor and Conservative voters.

To determine the degree of the relationship between sociodemographic traits, political attitudes and vote choice, and using items selected based upon the findings in the discriminant analyses, separate polychoric correlations by twin pair zygosity and opposite sex twin pairs were calculated for each phenotypic trait using PRELIS 2 (Jöreskog and Sörbom 1999). Polychoric correlations between voting behavior and the selected sociodemographic and political items were also calculated using PRELIS 2 for males and females separately (95% CI). The observed frequencies for each of the ordinal phenotypic traits were fitted to a threshold model that assumes that each variable has an underlying normal distribution of liability (Neale and Cardon 1992). The thresholds are expressed as z values which discriminate between categories that correspond to the frequency of the sociodemographic and political vote choice indicators. Thresholds were tested for similarity across sex and across twin zygosity groups. Thresholds were corrected for age effects.

Univariate Analyses

Similar to previous analyses in this study, using structural equation modeling, the variance of the phenotypic traits can be decomposed into an additive genetic component (A), common environmental (C) and a unique environmental components (E). Univariate genetic models using raw data were fit to vote choice, sociodemographic indicators and the political items selected based upon the findings in the discriminant analyses. Mx 1.60 (Neale et al. 2003) was used for genetic model fitting. Correlations between the latent additive genetic factors were 1 for monozygotic twins (MZ) and .5 for dizygotic twins (DZ), including opposite sex pairs (OS). Correlations between the latent common environment factors were 1 in both MZ and DZ twin pairs. As the data of opposite sex DZ twin pairs were available, non-scalar sex-limitation models were used to analyze the data. Sex limitation models assume the same sources of variation for males and females, but allow for differences in the extent to which the same genetic and environmental factors influence a trait. Ninety-five percent confidence intervals for each element of A, C and E were estimated in Mx. Sex and age were also included in the threshold model to control for any relationship between these fixed effects and vote choice.

Multivariate Analyses

Several Cholesky decompositions were used to assess the extent to which the heritable and environmental components of vote choice were explained by (1) the genetic and environmental influences shared with the selected sociodemographic indicators and political attitudes and (2) the genetic and environmental influences not shared with sociodemographic indicators and political attitudes and therefore specific to vote choice. As implied, the Cholesky decomposition is only valuable in multivariate analysis of simultaneously measured correlated variables if the variables are placed in a "rationally defined order of priority" which fits the logic of the construct under analysis (Loehlin 1998). This order is discussed later.

Mx 1.60 (Neale et al. 2003) was used for the Cholesky analyses. In order to reduce complexity multivariate analyses were restricted to same sex twin pairs for whom complete data were available. Analyses were performed for each sex separately and all multivariate structural equation modeling was conducted on polychoric correlation matrices using maximum likelihood estimation based upon the asymptotic covariance matrices supplied by PRELIS 2 (Jöreskog and Sörbom 1999).

Sub-models and Model Fitting

Several models were fit to the data to test the possibility of different genetic and environmental components of vote choice. For both the univariate and multivariate analyses, in order to determine the importance of the A, C and E components, the full ACE models were tested against progressively reduced models as explained previously. Model fit is also assessed in a similar manner to the previous analyses.

Results

Voting preference was answered by 5594/6325 (88%) twin individuals from the older cohort and 3459/5051 (69%) from the younger cohort for a total response of 9,053 (80%). Because of missing values for covariates, the use of only Labor and Conservative voters, and the use of only same sex twin pairs in the multivariate analyses, the numbers for some analyses will be smaller. Conservatives accounted for 46% of the sample, Labor 35% and Democrats 6%. The official voter turnout in the 1990 election was 43.5% Conservative, 39.4% Labor and 11% Democrat. In comparison to the general public at the time of the survey our sample slightly favored the Conservatives vs. Labor (about 3-4%), and under represented Democrats (about 5%). The total sample was 61.4% female and 38.6% male, thus our sample favored females. The age range was 18-88 (mean = 34, standard deviation = 13.8) and the mean age was 38 years old for Conservatives, 35 for Labor and 31 for Democrats. Voters in the younger age groups from 18-34 supported Labor over Conservatives by over 10 percentage points, and voters over 55 gave greater support (25-40%) to Conservatives over Labor. These results were similar to the voting habits of the general public (Newman 1996; Curtin 1998).

Educational levels were fairly similar for Conservative and Labor voters, while Democrats were noticeably better educated having almost twice as many people with degrees (32%) than Labor or Conservatives (16% and 17% respectively) (Table 21). More Labor voters identified themselves as working class (34%) than Conservatives (20%) or Democrats (25%). Conservatives were significantly more religious than Labor or Democrats, with 89% identifying with a religion, and 35% attended religious services at least once a month, while Labor and Democrat voters were much less likely to identify with a religion (75% and 70% respectively) or regularly attended church (23% and 24% respectively).

Table 5.21: Distribution of Age, Education, Social Class, Religion and Church Attendance by Voting Preference (%)

	Conservative	**Labor**	**Democrat**
Age			
Mean (SD)	37.1 (15.2)	34.1 (13.4)	30.2 (10.1)
Education			
< 7 years	1.4	1.3	0
8-10 years	24.0	24.4	14.6
11-12 years	27.5	24.8	22.2
Apprenticeship/Diploma	15.9	13.2	14.2
Tech/Training College	13.9	13.1	16.8
Undergraduate	12.6	16.1	26.9
Postgraduate	4.7	7.1	5.3
Social class			
Working	19.9	34.1	24.9
Middle or Higher	80.1	65.9	75.1
Religious denomination			
None	10.8	24.8	30
Evangelical/Fundamentalist	9.2	5.0	6.7
Other Protestant	56.0	39.4	37.3
Catholic	21.3	26.5	19
Jewish	0.6	0.7	1.0
Orthodox	0.5	1.4	1.2
Other	1.6	2.2	4.9
Church attendance			
2+ Weekly	7.4	4.1	6.7
Weekly	16.8	11.4	9.8
Monthly	11.0	7.40	8.3
Yearly	20.2	17.2	19.4
Rarely	44.6	60.0	55.8
N[a]	4222	3191	519

Note: (a) Due to missingness, cases for Conservatives range from 4080-4222, for Labor 3079-3191 and Democrats 506-519.

Discriminant Analysis

Table 22 presents only the political items that most discriminate between voting behaviors. Comparing Conservative and Labor voters, attitudes on socialism, medicare, trade unions and private schools had both the lowest Wilks' Lambdas and the highest standardized function coefficients, indicating they are the strongest discriminators. Conservative voters tended to be in favor of royalty, strict rules and private schools, and against socialism, trades unions, gay rights and teenage dole (unemployment benefit). Labor voters are much more favorable to medicare (free universal access to health care) and less favorable to privatization. A second discriminant analysis found that defense spending, gay rights, conservation, and disarmament are the best discriminators distinguishing Democrats from all others (Table 22). Based upon these results, the following six variables were identified as most strongly associated with voting preference (Con vs. Lab): two sociodemographic indicators of social class and church attendance, as well as four political attitudes on socialism, medicare, trade unions, and private schools.

Table 5.22: Attitude Items (% yes) that Best Discriminate Between Conservative, Labor and Democrat Voters (Vote Choice)

	Conservative	**Labor**	**Democrat**
Conservative vs. other			
Socialism	11	37	27
Medicare	54	85	77
Trade Unions	32	64	60
Royalty	67	43	41
Gay Rights	23	42	53
Privatization	54	35	42
Strict Rules	70	53	43
Teenage Dole	14	29	28
Private Schools	83	65	70
Democrat vs. other			
Conservationists	65	75	88
Defense Spending	69	52	39
Multiculturalism	62	71	81
Disarmament	57	72	83
Total N	4189	3174	516

The findings in the preliminary and discriminant analyses add further support to the use of the Australian Twin Registry as representative of the general voting public in 1990. The vote choice self reports in the Australian Twin Registry 1988-1990 survey would have accurately predicted the Conservative gains in the federal elections of 1990 (Ward 1990). Furthermore, the main political issue differences between the parties found in the extant literature (Jaensch 1989; Warhurst 1997; Grattan 2000; Moon and Sharman 2003) are also those identified by our statistical analyses performed on our sample.

One could make a significant argument to include Democrats with the Conservatives as roughly half of the Democrats have joined the Conservatives since 1990 (the other half joined the Greens). However, while the Democrats may appear more similar to Conservatives than Labor on economic issues, the Democrats are also more similar to Labor than Conservatives on social and environmental issues. Furthermore, as emphasized in their "Keep The Bastards Honest" party slogan, the Democratic Party positions itself as a voice for voters to check the powers of the current government, regardless of who is in power, whether Labor or Conservative (Simms 1996). Based upon their differentiation from both major parties and due to Democrats being a minor element in Australian electoral politics (making up less than 5% of the sample), only data for Labor vs. Conservative voters will be reported in the subsequent analyses.

The phenotypic polychoric correlations by twin pair zygosity are shown in Table 23. Table 24 presents the polychoric correlations between items for females and males. Correlations were higher for MZ pairs than DZ pairs and in most traits higher for males than females. There are also some substantial differences in the correlations of opposite sex pairs compared to those for same sex DZ pairs. These results led us to examine several models to explain the sources of variation, including univariate sex limitation models, and nested models that equate the path components for men and women.

Table 5.23: Twin Correlations for Voting, Sociodemographic Traits and Key Political Attitudes (Vote Choice)

	MZF	**DZF**	**MZM**	**DZM**	**DZOS**
Con vs. Labor	.79	.68	.84	.83	.64
Social Class	.62	.45	.67	.51	.48
Church Monthly	.63	.44	.69	.54	.44
Socialism	.38	.23	.42	.26	.13
Medicare	.46	.29	.48	.30	.14
Trade Unions	.43	.23	.45	.38	.28
Private Schools	.41	.34	.56	.47	.33
N Pairs[a]	1239	732	579	328	782

Note: (a) Correlations were estimated by full information maximum likelihood observations on incomplete pairs. Due to missingness complete pairs range from: MZF (1133-1239), DZF (689-732), MZM (528-732), DZM (308-328).

Table 5.24: Polychoric Correlations[a] between Vote Choice, Political Attitudes, and Sociodemographic Covariates; Males Upper Triangle, Females Lower Triangle

	Males (N = 3140)							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Cons vs. Labor	.	-.14	-.16	.49	.54	.44	-.26	.02
2. Social Class	-.20	.	.17	-.03	-.14	.00	.28	.20
3. Church Monthly	-.18	.11	.	-.12	-.08	.01	.29	.25
4. Socialism	.38	-.08	-.13	.	.46	.39	-.25	-.07
5. Medicare	.43	-.15	-.04	.36	.	.39	-.12	-.07
6. Trade unions	.44	-.06	-.03	.36	.34	.	-.08	.14
7. Private schools	-.25	.24	.23	-.18	-.16	-.07	.	.09
8. Age	-.01	.01	-.22	-.23	-.14	-.05	-.01	.
	Females (N = 5388)							

(a) Listwise deletion

The Heritability of Vote Choice

Univariate models containing additive genetic, common environmental and unique environmental variance components were fitted to determine which model best explains voting behavior (Table 25). After testing for the need to correct for sex, no significant sex differences in the thresholds were found. The sex-limitation model containing additive genetic, common environment and unique environment components (ACE) for females, but only common environment and unique environment components (CE) for males was not significantly different (p=.99) than the full sex limitation model and provided a more parsimonious fit (0 change in chi-square, for 1 degree of freedom). According to the ACE/CE model, the heritability of vote choice for males was zero, with common environment accounting for the majority of variance (.83), and the heritability of vote choice for females was .28 with common environment accounting for .52 of the variance.

However, the ACE model that equated all paths for males and females (assuming no sex differences in variance components) also did not provide a significantly worse fit (.053) compared to the full ACE model, and provided a similar AIC as the model removing A from males (Table 25). This model found that the additive genetic factors of vote choice accounted for 24% of the variance and common environment 58% of the variance in both males and females (Figure 5.3). Due to the marginal significance of the model that equates all paths for females and males, and the possibility that with increased power the confidence intervals would tighten thus making the model significantly different, it cannot be stated with certainty that the model equating all paths for males and females is the best fitting model for voting behavior.

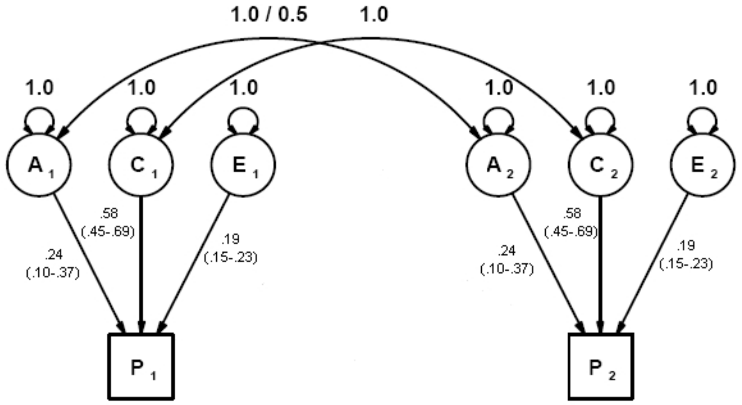

Figure 5.3 - an ACE diagram for vote choice in the Australian vote choice data

Univariate analyses were also conducted for each of the six vote choice correlates previously identified, and ACE models were fitted to estimate genetic and environmental variance components. The saturated ACE model that equated all variance paths for males and females was the best fitting model for church attendance (a^2 =.37), social class (a^2 =.31) and attitudes on private schools (a^2 =.19). However, removing the common environment component from attitudes to socialism (a^2=.39), medicare (a^2 =.47) and trade unions (a^2 =.45) did not significantly worsen model fit. Models containing both common and unique environmental variances only (CE model) fit significantly worse for all items.

Table 5.25 . Standardized Variance Components (95% CI) Sex Limitation Model Fitting for Vote Choice (Labor vs. Conservative); Thresholds Corrected for Age[a]

	Parameter Estimates										
	Females			Males							
Model	a^2	c^2	e^2	a^2	c^2	e^2	-2LL	ΔX^2	Δdf	AIC	p-value (comparison model)
ACE	.28 (.15-.46)	.52 (.36-.63)	.19 (.15-.25)	0 (.00-.00)	.83 (.63-.88)	.17 (.12-.22)	7282.45	-	-	-4681.55	-
ACE Females CE Males	**.28 (.15-.46)**	**.52 (.36-.63)**	**.19 (.15-.25)**	**-**	**.83 (.63-.88)**	**.17 (.12-.22)**	**7282.45**	**0.00**	**1**	**-4681.01**	**.99 (ACE)**
AE	.82 (.78-.87)	-	.17 (.13-.22)	.88 (.82-.92)	-	.12 (.08-.18)	7354.80	72.35	2	-4613.20	<.001(ACE)
CE	-	.73 (.68-.77)	.27 (.22-.32)	-	.80 (.74-.86)	.20 (.14-.26)	7298.90	16.45	3	-4669.10	<.001(ACE)
E	-	-	1	-	-	1	8093.16	810.71	4	-3872.02	<.001(ACE)
ACE (M=F)	**.24 (.10-.37)**	**.58 (.45-.69)**	**.19 (.15-.23)**	**.24 (.10-.37)**	**.58 (.45-.69)**	**.19 (.15-.23)**	**7290.13**	**7.68**	**3**	**-4679.85**	**.053 (ACE)**

Note: (a) Preferred models in bold.

In social science terms, for all items examined a genetic component was present, but common environment accounted for none of the variance in socialism, medicare, or trade unions. Unique environment was present in all items. However the vote choice results are not as clear as I could hope. Two models fit almost equally; one model equated the variance of males and females and shows a .24 additive genetic component for vote choice. The other model shows a strong additive genetic component for females, but none for males. As females make up the majority of the sample, and there is little reason to believe that the phenotype would have an entirely different genetic component in males than females, and the model AIC of the MF equated model fit better, it is seen as the superior model. However additional data from parents and non twin siblings in future analyses should be used to clarify this finding.

Multivariate analysis

The interpretation of the Cholesky decomposition depends on the ordering of the variables. Accordingly, the ordering depends on the theoretical logic of voting behavior. In our model and as referenced in the extant literature, attitudes are influenced by sociodemographic traits and not vice versa (Campbell et al. 1960; Page and Brody 1972; Martin et al. 1986; Merelman 1986). Therefore sociodemographic traits were placed first. It is widely accepted in the survey research literature that people use a general semantic picture or reference framework to answer specific issue questions (Tourangeau et al. 2000; Sudman et al. 1996). In other words, a general construct incorporates the specific one; but not the other way around. Hence, the construct of socialism was ordered after the sociodemographic traits, but prior to the remaining political issues. The remaining traits were ordered based upon their relative strength to voting as reported in the discriminant analyses.

Standardized factor loadings for the full Cholesky are shown in Tables 26 (females) and 27 (males). The saturated model assumes that the genetic variation of voting is determined by a genetic component underlying voting as well as all the other variables in the model. In the saturated model, the remaining A and C specific to vote choice were 0 for both females and males, and the specific E (including measurement error) was .45 for females and .32 for males.

Table 5. 26: Cholesky Decomposition Standardized Path Coefficients- Saturated Model (Females) –Vote Choice

Additive Genetic Factor

	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**
Class	-.45						
Church	.18	.49					
Socialism	-.14	.22	.39				
Medicare	-.05	.27	.26	.47			
Trade Unions	-.06	.13	.15	.22	.40		
Private Schools	-.18	-.12	-.34	-.05	-.11	.00	
Vote Choice	-.04	.04	.44	.06	.34	.00	.00

Common Environment Factor

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
Class	-.66						
Church	-.02	.63					
Socialism	.21	.07	.28				
Medicare	.14	-.06	.13	.22			
Trade Unions	-.02	-.02	.38	.03	.00		
Private Schools	-.28	-.16	.18	.06	.36	.05	
Vote Choice	.32	.29	.30	.39	.03	.00	.00

Unique Environment Factor

	E1	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**
Class	.65						
Church	-.07	.52					
Socialism	.01	.01	.77				
Medicare	-.13	-.05	.21	.68			
Trade Unions	-.05	-.03	.21	.09	.74		
Private Schools	.08	-.04	-.10	-.08	-.03	.71	
Vote Choice	-.14	.05	.16	.21	.11	-.06	.45

Several reduced models were analyzed (Table 28). Removing the entire additive genetic component (A) or common environment component (C) for all items significantly worsened model fit for both males and females. However, in the saturated model for both males and females, the loadings on the last two genetic paths were near zero, indicating no unique genetic component specific to vote choice, which suggests the model could be further simplified by removing specific genetic paths to vote choice.

Table 5.27: Cholesky Decomposition Standardized Path Coefficients- Saturated Model (Males) –Vote Choice

Additive Genetic Factor

	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**
Class	-.60						
Church	.04	.33					
Socialism	-.33	-.35	.12				
Medicare	.04	-.23	-.18	.23			
Trade Unions	-.18	-.06	-.21	.02	.00		
Private Schools	.02	-.20	-.39	-.15	-.01	.00	
Vote Choice	.16	-.18	.32	.16	.01	.00	.00

Common Environment Factor

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
Class	-.62						
Church	.22	.78					
Socialism	.30	.08	.43				
Medicare	.34	.20	.44	.11			
Trade Unions	.10	.14	.59	-.17	.00		
Private Schools	-.42	-.10	-.05	.47	.00	.00	
Vote Choice	.34	.20	.70	.11	.00	.00	.00

Unique Environment Factor

	E1	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**
Class	.52						
Church	-.05	.47					
Socialism	-.07	.11	.68				
Medicare	.14	-.07	.24	.64			
Trade Unions	-.12	-.05	.15	.16	.68		
Private Schools	.15	-.13	-.07	-.14	.05	.58	
Vote Choice	-.02	.03	.24	.10	.12	-.15	.32

Removing the additive genetic path specific to voting provided a significantly worse fit for females (p=.02), but not males (p=.30), presenting similar results to the univariate analyses. However, upon further examination of the factor loadings, the socialism factor accounted for a majority of the genetic variance in vote choice. A separate reduction of the model by dropping all genetic paths to voting except socialism provided a non significant chi-square difference compared to the full model for both females and males (p=.97 and p=.67 respectively). This model also had a lower AIC (more parsimonious fit) compared to the reduced model that removed all genetic paths to voting for males. Any further reduction of the model by dropping the additive genetic path of the socialism factor to vote choice did not provide a significantly better fit. Therefore the best fitting model for both males and females was the reduced ACE model that removed all the unique additive genetic paths to voting except from the latent additive genetic loading of socialism (Table 28).

Table 5.28: Seven-variate Cholesky Decomposition Genetic Model Fitting for Vote Choice (Males and Females Analyzed Separately)[a]

Females

Model	AIC	ΔX^2	Δdf	p-value (comparison model)
ACE	-143.10	-	-	-
ACE (Removed all A to Voting)	-140.54	16.56	7	.02 (ACE)
ACE (Removed A to Voting except Socialism)	**-153.76**	**1.34**	**6**	**.96 (ACE)**
AE	-106.34	92.76	28	<.001 (ACE)
CE	-141.45	57.65	28	<.001 (ACE)
E	1220.28	1475.38	56	<.001 (ACE)

Males

Model	AIC	ΔX^2	Δdf	p-value (comparison model)
ACE	-67.76	-	-	-
ACE (Removed all A to Voting)	-73.42	8.33	7	.30 (ACE)
ACE (Removed A to Voting except Socialism)	**-77.67**	**4.08**	**6**	**.67 (ACE)**
AE	93.82	217.58	28	<.001 (ACE)
CE	-84.46	45.30	28	.02 (ACE)
E	940.80	1120.55	56	<.001 (ACE)

Note: (a) Preferred models in bold.

Of significant importance, and similar to the additive genetic factor, the final common environment factor loading on vote choice is zero for males and females. Thus the only component of the Cholesky decomposition that provided a specific influence on vote choice, is unique environment (Tables 26 and 27). After all other unique environmental variance is accounted for by the vote choice correlates, the unique environment (including measurement error) specific to vote choice accounts for 20% of variance in females and 10% in males.

Vote Choice Discussion

Similar to analyses utilizing earlier rounds of data from the HLQ study, this examination found that there are genetic, common, and unique environmental variance components to political attitudes (Martin et al. 1986; Truett et al. 1992; Posner et al. 1996). In particular, the central finding is that vote choice is heritable (.24), but the change in -2LL approached significance (p=.053), suggesting it was only just possible to equate the variance components for males and females.

However, the multivariate results provided a strong indication that the genetic component of voting for both sexes was shared with the same genetic variability influencing its covariates. There was no evidence that the genetic variability in vote choice was determined by a unique genetic component. Specifically, the best fitting model dropped all the genetic paths to voting except socialism, suggesting an underlying genetic component of voting where the variation is largely accounted for by the latent factor of socialism. Although the HLQ questionnaire asked an opinion on “socialism,” the term was not defined. Therefore we must take care elaborating on its meaning. Based upon socialism’s strong correlation with medicare and trade unions one could speculate that it is a substitute for social responsibility. However, an alternative explanation could be that negative attitudes toward socialism are a proxy for lack of support for handing over individual responsibilities to government control or collectives (unions). Therefore, for Australian voters the additive genetic component of voting is likely related to either social responsibility or personal accountability.

This is an important finding. One’s feelings of social responsibility or personal accountability influencing political activity are not groundbreaking. However these are not thought to be genetic components, rather to be social ones. Genes, influence our social preferences, which in turn influence our social behaviors. These behaviors are of course reinforced by our social influences and personal experiences.

In addition to the genetic examination of voting, the common environment component is also entirely accounted for by the first six elements of the model in both males and females. It is widely assumed in the political science literature that the common (family) environment is the major source of political partisanship and voting behavior (Campbell et al. 1960). However, while common environment accounted for a significant portion of the variance in the univariate analyses, the multivariate results provide no evidence of a specific common environmental influence on vote choice. Rather, the common environment component is part of an overall construct that influences one's attitudes and voting preferences. Further confounding the issue, previous studies found the common environment component of certain social and political items was to a great extent attributable to assortative mating (marrying alike) and not familial socialization (Eaves et al. 1999). Thus, an additive genetic component in voting (accounted for by its covariates) was found, but no common environment component specific to voting, the first of our theories, the socio-psychological model (common environment specific to voting) was not supported by the data used here. Indeed, unique environment was the only residual variance specific to vote choice, lending some support to existing voting studies that focus on the unique environment (Zaller 1992).

While these findings do not disprove the rational choice theory of voting behavior, a strong argument can be made that rational choice is incomplete. The underlying voting factor does have a heritable component (up to .28) as did the individual political items that accounted for voting's additive genetic component in the multivariate analyses. As such, it appears that rational choice is a plausible vote choice model, but only if the "black box" of preferences allows for a genetic component and the theory relaxes the requirement that people must be aware of their genetic preferences. In other words, genes may provide the framework for evaluating voting alternatives and making the "rational" choice.

The present study has several important limitations. The use of the phrases "*Generally speaking*" and "*usually*" in the question used to assess vote choice implied discounting the current election or any unique environmental circumstances. The question did not ask how respondents specifically voted in the last election, but rather how they normally vote. In addition the phrased used in the study were not typical of those found in vote choice studies, such as "Who did/do you vote for?" As such, phrasing of the question may reduce specific election year environmental fluctuations, and confuse the voter.

A second limitation is the nature of Australian politics during the year surveyed. Minority party support was at a record high in 1990. By 2006 Australian politics have largely returned to a two-party system, justifying the removal of the Democrats from the analyses, but this removal also reduced our sample size by about 5%. In order to ensure that this exclusion did not distort our results separate analyses combining the Democrats with the Conservatives was also performed, which resulted in only minor differences in our findings. Finally, by utilizing covariance matrices computed by PRELIS 2 only pairs with complete data contributed to the multivariate analyses. This was done because of the numerical problems and extremely long run times that frequently beset multivariate analyses with large numbers of categorical variables. The multivariate findings were validated by verifying that the Cholesky component results fell within the confidence intervals of the univariate analyses, which were performed using raw data.

Overall Conclusions

Previous genetic studies examining political traits have been limited to attitudes (Martin 1987; Eaves et al. 1989; Truett et al. 1992). Missing in the extant literature are examinations of political actions and behaviors, such as voting and party identification. While traditionally the social sciences have viewed twin studies as only a means to proscribe additive genetic influence, twin data also provide a means to partition out environmental variance into that which is common to members of a family and that which is unique to the individual, thus allowing political scientists a technique to examine different sources of preferences and validate existing theories.

Our three analyses of party identification, strength of identification and vote choice offer the full spectrum or variance components results. PID is a CE model primarily driven by common environment. While using only prominent or key issue positions accounted for little of the variance, using current methods, I could not completely discount that the common environmental component did not come from the socialization of all political issue positions. However we can validate the Michigan model's overall thesis that PID is driven by familial socialization.

Strength of partisanship in something rarely, if ever, discussed in the political science literature. For certain much attention is given to the vote choice of strong partisans, weak partisans and independents in particular; but why people are independent, weak or strong partisans is largely looked over. In these analyses, strength of partisanship is an AE model; the primary reasons why someone is a strong partisan is half genetic and half personal experience while familial socialization has no significant bearing.

Finally vote choice is a mixed bag; all three components are present, with common environment accounting for the majority of variance, but some genetic and some unique experience is present as well. As the relationship between partisanship and vote choice is well documented and partisanship is primarily C, this makes sense. However in the multivariate, the genetic component of vote choice was largely driven by the genetic variance of socialism, and only the E component remained specific to vote choice. Voting is complex, and while the choice of which party one selects is driven by familial socialization, the intensity of party loyalty is driven by familial genes, voting is combination of the two - the motivation it takes to vote, and personal experiences one uses to make a vote choice, and the familial socialization of preferences as well as the genetic ones for certain issues and constructs. Clearly there is no voting gene, but genetic preferences do affect vote choice indirectly. However, whether or not there is strength of political intensity gene remains to be seen.

While these results provide an insightful look at the source of variance, instead of just the manner in which certain components affect vote choice or party identification, the classical twin design analyses may not always be appropriate for establishing the source of variance in political behaviors. The act of voting and party affiliation are only part of the complex interdependent and context dependent social attitude factors that are both genetically and environmentally influenced (Martin et al. 1986; Zaller 1992; Hermann 2002). Utilizing other methodologies including the extended twin family design (ETFD) or direction of causation models will also undoubtedly provide further insight. The ETFD's use of more parameters allows for the simultaneously estimation of common environment and non-additive genetic effects, as well as assortative mating. The next step logical step is to apply the ETFD to these analyses which requires the addition of parental and non twin sibling data. Given the relative absence of studies conducted on genetic influences on political behavior, these findings present an important examination of genetic influences on vote choice, and a significant contribution to the literature that may have substantial implications for future research in this area.

Chapter 6 – Biological Sex Differences or Gendered Socialization?

In 2005, then Harvard President Lawrence Summers posed three hypotheses as to why women and men differ in professional success and academic prowess: the desire for high powered jobs, intrinsic aptitude, and socialization (including discrimination). Summers' hypothesis that men and women have different intrinsic abilities, and this difference in ability is partly due to their success or lack thereof, gained the most attention:

> "…there are issues of intrinsic aptitude, and particularly of the variability of aptitude, and that those considerations are reinforced by what are in fact lesser factors involving socialization and continuing discrimination…the field of behavioral genetics had a revolution in the last 15 years, and the principal thrust of that revolution was the discovery that a large number of things that people thought were due to socialization weren't, and were in fact due to more intrinsic human nature, and that set of discoveries, it seemed to me, ought to influence the way one thought about other areas where there was a perception of the importance of socialization…" (Summers 2005)[108]

While a number of studies find that women perform better on verbal and memory tasks, whereas men excel in spatial tasks (Gur et al. 2002), there is inconsistent evidence to support an inherent difference in cognitive ability on a generalizable scale (Petrill and Thompson 1994). Contrary to the public interpretation of Summers' statements, there is ample evidence that women can do as well as men in science or math (Hyde and Linn 1988; Hyde and Lamon 1990; Bussey and Bandura 1999; Correll 2004). Of the evidence that exists regarding intellectual superiority, some works favor females over males in both cognitive capacity and early childhood development (Halpern 1986; Cahill 2005). At this stage the scientific community is unable to determine the overall difference in potential cognitive capacity by sex, if even there is a difference. Furthermore scholars disagree if current examinations are measuring ability at all (Gur 2002; Cahill 2005).

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[108] Shortly after his speech at the National Bureau of Economic Research Conference on Diversifying the Science and Engineering Workforce, Summers found himself in a growing controversy; he received a vote of no confidence from the professors at Harvard, as well as numerous rebukes in the media, academic community and various other groups (Sanoff 2005; Bombardieri 2005). Summers was censured and many at his institution asked him to step down as president (Rimer 2005).

However, we cannot completely discount inherent determinants of behavior based upon sex. While Summers' statements - taken to mean that social behavior differences between the sexes was dictated by capacity - may not be empirically sound, an alternative argument that socialization is not the only important correlate to behavior differences between the sexes has merit. There is considerable evidence that behavioral differences are heritable and are in part due to genetic variation (Brody 1985; Martin et al. 1986; Martin 1987; Truett et al. 1992; Posner et al. 1996; Blum 1997; Eaves et al. 1998; Eaves et al. 1999; Olson et al. 2001; Bouchard et al. 2003). In essence we have the capacity to do what we choose, but we are often influenced on what we are choosing by our biology, specifically by our sex. Sex affects our choices in social behaviors, but does not necessarily predetermine them or limit them by capacity. Although cognitive ability and social behavior are different, Summers intersects the two as he challenges social conditioning with cognitive capacity. While there may be little interest in exploring the differences in political choice due to cognitive capacity between the sexes (if there is a difference), the underlying question of inherent social and political behavior differences between the sexes is of great importance as there remains a dearth of literature with regards to political behaviors.

The main focus in the political behavior literature regarding gender and political opinion points toward the greater attraction of the Democratic Party to women than men, and the greater support women give to liberal issue positions (Shapiro and Mahajan 1986; Cook and Wilcox 1991; Seltzer et al. 1997; Howell and Day 2000).[109] This "gender gap" has explanations centered on policy preferences and numerous works focus on examining which issues are more salient to women. Regardless of the focus on the different sets of issues, the overwhelming amount of research is based on socialization and environmental factors (Trevor 1999; Howell and Day 2000). In short, the assumption is that women have certain policy preferences because of their social identity, placing the majority of behavior differences on socialization (common environment).

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[109] Somit and Watts (1994) explain the difference between sex and gender; "sex is a biological term that relates to the fundamental reproductive strategy of a species; gender is an analytic concept for the most quintessential cultural of sciences: linguistics."

This chapter expands upon the traditional social science approach used to examine the difference in political behavior between the sexes by combining the research programs of the biological and social sciences used to examine behavior. Utilizing evolution and biology as the theoretical basis for the development of human origins and subsequent political behaviors, and behavior genetics as the empirical information about human nature, this chapter empirically examines the genetic, socialization, and personal experience components of political behavior, with specific interest in the different genetic variance components estimates for males and females.

In surveys of adult US and Australian twin pairs, respondents were asked to indicate their usual attitudes on contemporary individual social and political items. The findings present significant differences in both the socialization and genetic variance components between males and females, providing evidence that not only do political behaviors have a genetic and heritable component, but the variability of these components are in part due to the difference in sex. While this examination does not look at the gender gap specifically, it indirectly sheds light on this phenomenon by examining whether men and women come by views in different ways, thereby offering a plausible explanation for the gender gap that is very different from the traditional political discourse.

Gender and Politics: the Traditional Discourse

Most studies discounted any gender difference in political attitudes until the 1980 presidential election between Jimmy Carter and Ronald Reagan, which launched a series of scholarly research directed at the gender gap in electoral politics in the United States.[110] Substantially more women voted for Carter, creating an 8 point gender gap (Seltzer et al. 1997). This partisan trend continued throughout the 1980s and 1990s, and climaxed in the 1996 election where 54 percent of women voted for Bill Clinton compared to 43 percent of men, creating an 11 point gender gap. A majority of research into investigating why women have different preferences has been explained by socialization (Chodorow 1978). Carol Gilligan’s (1982) work is most often cited; her

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[110] Gerald Pomper (1975) conducted one of the first main stream studies examining difference in gender attitudes which focused on war, however Pomper concluded the view was only temporary.

primary thesis is that women and men approach ethics from different perspectives; women's psychology is based on an ethic of care, versus men's ethic of rights or justice; women are caretakers or nurturers whereas men are not.

Initial research focused on positions regarding abortion and equal rights (Norrander 1999); however these predictors turned out to account for little of the variance and subsequent explanations focused on gendered attitudes towards violence (Smith 1984), foreign policy (Togeby 1994), and criminal justice (Hurwitz and Smithey 1998). Men were more likely to support the use of force or violence at home or abroad by more than 9 percentage points on average (Tom Smith 1984) and women in the US were more pacific than men, and are less willing to use force in foreign policy, and less apt to go to war (Conover and Sapiro 1993; Togeby 1994). Women are more afraid of crime as they see themselves more vulnerable, and are more supportive of prevention policies, support more gun control measures, and are more likely to convict those accused of violent crimes (Hurwitz and Smithey 1998). Women are also more favorable to stronger punitive measures for rape and domestic violence, but there is inconsistent evidence when it comes to punishment in general. There is considerable evidence that women are more likely to support liberal positions on issues that relate to the use of force and the budget (Shapiro and Mahajan 1986; Abramson et al. 1998). Overall, on issues regarding public protection or "compassion" such as education, welfare, minorities, helping the poor, sick, elderly or unemployed, women are substantially more concerned than men and more likely to support the liberal position. Due to these issue position differences, women are more likely to identify as Democrats (Shapiro and Mahajan 1986; Cook and Wilcox 1991).

Some researchers have attempted to look at the differences in policy preferences by looking into emotional responses to social problems, awareness to problems, and perception of fairness in existing social institutions (Schlesinger and Heldman 2001). However this line of research stayed in the conventional end of the pool, only going so far as looking into the different perceptions of the issues; they did not delve into indicators outside of environmental factors to explain why the perceptions are different, such as cognitive processes (not capacity), neuropsychological factors or differences in the biological environment (in-utero etc.).

Carroll (1988) provides one of the most comprehensive socialization frameworks to explain the gender gap, combining vulnerability, mobilization, autonomy and nurturance. Due to women's position as a more vulnerable group and their own disadvantage in society, they support positions to protect similar groups; thus certain issues become women's issues that develop a mobilization effect where women are more likely to favor candidates taking on such issues.[111] Equal rights, reduction in domestic abuse, and abortion rights are nice examples.

Autonomy in women emerged from the small changes in the male dominated power structure. For example, as society changed and more women entered the work force, women experienced job discrimination first hand, thus becoming attuned to equal rights and discrimination issues and more likely to support all women's issues.[112] Carroll and others give us useful frameworks for the environmental analysis of behavior, but cannot explain sources of variance outside of environmental factors, as they only look at external considerations.[113] Empirical evidence based upon these assertions is present throughout the social science disciplines and even in economics.[114] In essence, the current literature on gender differences in political behavior has little to do with biological sex, rather it is due social, cultural, personal and economic conditions based on gender.

As reviewed in the literature, a substantial portion of the research on sex differences has been largely based on Gilligan's theoretical premise. And as such most

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[111] For more on the perceptions of vulnerability see Gilligan (1982).

[112] Carroll (1988) also addresses the history of women's role as the caretaker thus making them more sensitive to nurturing issues and social polices.

[113] Sapiro and Conover (1997) posit that in order to examine gender differences in behavior we must examine them as structural and positional relationships. Structural explanations encompass situations where when men and women take different considerations into account when making a choice and positional explanations include when men and women arrive at a different choice when taking the same considerations into account.

[114] One such example is Edlund and Pande's (2002) finding that more women than men favor the Democratic party in the US due to the decline in marriage, which has made men richer and women poorer.

research utilizing Gilligan's work assumes this difference in psychology is socially constructed; however, Gilligan (1982:2) does not appear to ascribe to this interpretation:

> "No claims are made about the origins of the differences described or their distribution in a wider population, across cultures or through time. Clearly these differences arise in a social context where factors of social status and power combine with reproductive biology to shape the experience of males and females…"

While Gilligan did not delve into the inherent, heritable or evolutionary possibilities as to where exactly the difference in psychology comes from, she did not deny those as potential origins. In a more recent work Nancy Chodorow (1995) suggests:

> "…gender cannot be seen as entirely culturally, linguistically, or politically constructed. Rather there are individual psychological processes in addition to, and in different register from, culture, language, and power relations that construct gender for the individual."

Both Chodorow and Gilligan present explanations for differences in behavior that are based on inherent value differences between men and women (Howell and Day 2000). If these psychological processes are inherent, we can also assume they are heritable, thus subject to biological and evolutionary hypotheses.

Evolution and "Gender" Politics

In the US, the political incorrectness of identifying, examining or hypothesizing about inherent or biological differences between men and women has reached a point where one misstep in words can unleash a firestorm of criticism. Some may say "rightly so", as the study of inherent genetic traits, when it comes to gender or race, is controversial and has been often framed to suit personal predispositions and further unsavory agendas (Somit 1976; Schubert 1991; Somit and Watts 1994; Campbell 2002). Clearly it has not always been in the best interest of furthering knowledge to entertain such studies and we have no need to regress back to the xenophobic, sexist and racist eugenics movements. However to ignore every aspect of inherent behavior differences between the sexes handicaps our ability to further knowledge and in order to explain the different political behaviors between men and women we must also address the biological possibilities on how inherent differences between the sexes affect political behavior.

Those in the fields of anthropology and evolutionary psychology do provide some potential bases for inherent differences in social behavior among the sexes. Men and women had different specialization requirements and these specializations developed different natural selection pressures for each group (Somit 1976; Somit and Watts 1994; Campbell 2002). Pack hunting and migrant family life required high degrees of cooperation and subordination. Although men and women were both subject to the constraints of the group and developed traits to be cooperative and hierarchical, the reasons for this cooperation and subordinate /hierarchical development differed for the sexes (Corning 1971).

Hunter Gatherer Social Roles and Reproductive Strategies for Males

According to the EP literature, males are primarily responsible for hunting and scavenging, defense of the group against enemies or predators, and finding, developing and using weapons.[115] Hunting requires communication among a group of men with similar physical and cognitive abilities. Violence and the use of force are positive behaviors; the alpha male is the one who can dominate others by force; hence the use of force to establish dominance is an adaptive trait. The males who are the most dominant have the most mating options. Power is the most desired trait for males. Because the reproductive rewards of competition are so much greater for males than females, males are more willing to risk their position (often their lives) in pursuit of power and mating (Corning 1971; Geary 1984).

For men natural selection favors competitiveness, risk taking and power acquisition, which entail higher political interest. According to Pratto (1996) men’s greater interest in political activities is a reflection of the sex difference in the general concern for the establishment and maintenance of social dominance.[116]

Hunter Gatherer Social Roles and Reproductive Strategies for Females

In the hunter-gatherer societies of our ancestors, a majority of the scholarly literature proposes women were primarily responsible for child rearing, gathering food

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[115] Men also foraged, and women may have helped in hunting, but predominately men were the hunters.

[116] Numerous observations in early childhood and adult development re-enforce these theories (Geary 1998).

near the home base, maintaining the home, preparing food and clothing, and caring for children; women were the societal grounding. Females are the members in the group that create permanence and bond by need for support against outside forces (Somit and Watts 1994). Child-care requires more advanced communication, recognition, and cognitive skills to interact and teach a child who is not fully developed, mentally or physically (Brody 1985). Mothers and women in general are the first line of defense for infants and young. In short, women "…have to be oriented to the needs of others" (Blum 1997; 67). This level of care and attention has a definite biological purpose; studies have shown that infants who receive physical and verbal attention gain weight 47 percent faster than infants denied attention given the same amount of food (Blum 1997; Campbell 2002).

For females it is proposed that there is a much weaker biological drive for power; women only need let the males compete for dominance ensuring the most able male is their mating partner. Women are more selective in their mates; they are quality not quantity investors (Campbell 2002). Dominant males offer protection and resources that increase the likelihood of their children surviving to maturity. Evolutionarily speaking, cooperation, care, rearing of young, and society foundation are the most desirable traits for female survival, individually and for the societal unit (Brody 1985; Geary 1998).

Summarizing the works of scholars using evolution to explain behavior, a significant portion of the difference in male-female behavior has roots in the desire for mating and power. It is in the best interest of males to mate as much as possible with as many females as possible, whereas females can only give birth every nine months. If a man remains completely faithful to one woman he can only produce as many children as his partner can give birth to, hence it is in the males evolutionary best interest to seek out as many mates as possible (Campbell 2002).

Modern Day Repercussions

Overall scholars speculate these differences in specialization have led to differences in modern day behaviors: women are more sensitive than men to non verbal cues, and to those in need; they are also less apt to show aggression than men and use language with more sophistication at an earlier age than men. Since women have stronger emotional responses to conflict they gain the extra ability to build stronger domestic support systems, while men spend more time developing power games and gain extra abilities in competition and a stronger propensity to use physical force.

Empirical observations have provided considerable evidence finding specific behaviors have a biological and evolutionary basis, including the nuclear family, antipathy for strangers, self motivated learning, exploratory behavior, territoriality, fear, ethical or authority-accepting behavior, play, peer-groups, aggressiveness, competitiveness, and hierarchical social groups (Corning 1971).

Using cross-cultural studies of children, John Dearden (1974) finds that the largest behavior differences between the sexes occurs in children between 3 and 6 years old, versus that of older children. Males develop stronger aggressiveness, outwardly directed predispositions, greater self-assertiveness, contentious tendencies, adventurousness and the need for individual achievement early on. Compared to males, females develop a more actively sympathetic disposition, inward directed demeanor, maternal impulses, domestic-social personal concerns, and more interest in art and literature at a very early age. Most political as well of other social scientists typically account for these differences as socialization; however if socialization were the main cause the gap should widen or have a more acute effect when we are more fully aware of our environment, not in the 3-6 year old range as Dearden finds.

Biology and Emotion: Not Just Socialization for Behavior Differences

Other examinations utilize bio-feedback to examine sex differences in behavior. Humans have universally recognizable facial expressions for emotion to communicate cues of reassurance, bonding, threat, and competition (Masters 1990); the ability to communicate and interpret these expressions is much stronger in female infants than males; overall women perform better in a wide range of emotion recognition tasks (Gur et al. 2002; Baron-Cohen 2003). Examining babies, as they have not yet been socially influenced, Baron-Cohen and Gur find that emotion recognition is in our genetic makeup, specifically our sex and not societal learned or environmentally driven. Previous studies by Goy and McEwan (1980) find that when shown the picture of a baby, females' pupils dilate, but men's do not. There is no social or environmental explanation for this difference; the difference is a biological reaction to external stimuli dependant upon the sex. These findings are consistent with the biological theories of emotional development. Facial expressions have a direct impact on our political behaviors. Experimental evidence finds that both the nonverbal displays in known and potential leaders and the ability of the electorate to interpret these expressions, interact with cognitive attitudes to form political opinions about political leaders (Masters 1990).

While the traditional social science literature find emotion as reasons for attitude difference in political behavior, most consider emotion to be socially constructed (Marcus 2002). However biological and evolutionary scholars argue that emotion is a biological function that is socially adaptive (Izard 1971; Plutchik 1991).[117] From a biological perspective emotion is primarily intended to communicate about survival-related approach or withdrawal processes. For example an expression of fear in women identifies potential threats to their young or others in the group. For men, fear expression weakens their group position. The evolutionary component is rooted in the foundation that men and women differ in their survival related functions (Brody 1985; Blum 1997; Geary 1998).

Although Baron-Cohen, Brody, Geary, Blum and others do not directly address political attitudes, their findings are consistent with the literature regarding women's political positions based on socialization factors; and there is substantial evidence that emotion affects our political positions (Gilligan 1982; Shapiro and Mahajan 1986; Cook and Wilcox 1991; Schlesinger and Heldman 2001). Several scholars go so far as to argue

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[117] Plutchik's psychoevolutionary theory of emotion posits 1) The concept of emotion is applicable to all evolutionary levels and applies to animals as well as to humans. 2) Emotions have an evolutionary history and have evolved various forms of expression in different species. 3)Emotions served an adaptive role in helping organisms deal with key survival issues posed by the environment. 4)Despite different forms of expression of emotions in different species, there are certain common elements, or prototype patterns, that can be identified. 5)There is a small number of basic, primary, or prototype emotions. 6)All other emotions are mixed or derivative states; that is, they occur as combinations, mixtures, or compounds of the primary emotions. 7) Primary emotions are hypothetical constructs or idealized states whose properties and characteristics can only be inferred from various kinds of evidence. 8) Primary emotions can be conceptualized in terms of pairs of polar opposites. 9) All emotions vary in their degree of similarity to one another. 10) Each emotion can exist in varying degrees of intensity or levels of arousal.

that emotion is the motivation for human behavior as well as the key component in our decision making processes (Dolan 2002; Marcus 2002). By evoking particular behavioral motivations relating to anxiety and fear, elites are able to alter individual decision-making processes, which, in turn, influence political participation. Given that susceptibility to framing effects extends to all segments of the population, regardless of socio-demographics or existing political knowledge (Nelson et al. 1997; Druckman 2004), emotions serve as universally powerful behavioral representations of human motivations, significantly affecting political decision-making behavior. Based upon the findings in the literature surveyed, emotion precludes rationality or familial socialization, but only at the end of the behavior "line"; evolutionary processes are very rational and this rationality just occurs at a different level.

Hormones and Behavior Differences

The current evidence on the evolved difference between men and women is not limited to experimental observation. Numerous studies have shown biological elements, with specific interest in hormones, androgens, and testosterone in particular, have a substantial effect on behavior. Due to the developmental differences in the male and female central nervous system in uteri, certain androgens are released in males and restricted in females. For the sake of time and space, it is not feasible to review what the androgens do in their entirety, however in human medical case studies, females born to pregnant mothers who were injected with androgens display the same behavior males usually do throughout their lives. In their youth, the androgen "treated" females are more vigorously active, prefer outdoor activities, play with "male" toys, are more self-assertive, and are highly competitive and take part in hierarchy positioning; dolls are rejected or relegated to secondary status. When they develop into adulthood romance and marriage take second place to career advancement and personal achievement (Dearden 1974).

Combining Biology and Traditional Political Familial Aggregation

These behavior differences between the sexes are not just limited to social or developmental aspects, but to all aspects of life including political aspects. Michael

Milburn and Sheree Conrad's (1996) examination of childhood corporal punishment and adult political ideology combines theories of biology and environment. In general they find a weak relationship exists where children of high corporal-punishment parents became conservative in adult life, and children of light punishment parents became liberal; but when controlling for the sex of the child, they find males of high punishment parents overwhelmingly became conservative in adulthood, with strong preferences for the death-penalty and use of military force; whereas women with high punishment parents became almost always liberal in adulthood. The females tended to put themselves in the place of those facing the use of force or punishment, and develop an empathetic and emotional connection to those in vulnerable situations. Without taking biology (sex) into account, Milburn and Conrad would have failed to see an important inherent distinction between male and female behavior; both groups were subjected to the same environmental stimuli early in life so other socialization factors are diminished, but both groups have a significant difference in behavior based on the interaction between biology (sex) and environment.

Behavior Genetics as the Nexus

Although there are no studies in the social sciences on the heritable differences in political attitudes between men and women, studies in behavior genetics examine sex differences in social behaviors and provide the foundation for future research in this area (Martin et al. 1986; Truett et al. 1992; Eaves et al. 1998; Eaves et al. 1999). Behavior genetics methodology as explained in chapter 3 allow for testing to see if we can equate the variance components between males and females, and thus determine if the genetic components in certain behaviors is more pronounced or reduced in either sex.

Analyzing responses to a 12 item subset of the Wilson Patterson Conservatism scale Alford et al. (2005) reported no substantial differences in heritability between the sexes.[118] However their study did not specifically test to see if the heritable differences in

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[118] They did however report previous studies by Martin et al (1986) that analyzed men and women separately that founds and find up to 35 point correlation coefficient differences in certain political attitudes between men and women. However Martin et al did not test to see if males and females variance components could be equated nor do they explain the differences between the sexes they found.

political attitudes between men and women were significant or if the variance components could be equated. Rather they combined males and females in all of their analyses. The following section re-analyzes the data used by Alford et al. (2005) (the Virginia 30k) and also incorporates the Australian HLQ data, to test for significant genetic difference in political attitudes between the sexes. The traditional literature founded on works by Chodorow (1978), Gilligan (1982) and Carroll (1988) assume sex differences in behavior are 100% due to socialization - this assumption needs to be tested.

Hypotheses

In effect, the assumptions in the social science and political science literature in particular are that 1) there are no genetic influences that cause behavior differences between men and women and 2) a majority of the variance between men and women is due to socialization (C) 3) females are more sensitive to socialization pressures than men and 4) females are more sensitive to socialization pressures and thus C should account for a majority of the variance in most traits.

In comparison, the hypotheses in the evolutionary literature are 1) different selection pressures create differences in the genetic sources of variance between the sexes and 2) these differences should be the greatest for items regarding power and mating. Using Pratto's (1996) logic, one should expect there to be significant differences in the additive genetic components between men and women on most issues, as their selection pressures have been different; they have developed differently and therefore address all things, including modern life differently, with the greatest genetic differences in issues of power and empathy.

Methods

Sample, Preliminary Analyses and Methodology

Similar with chapter 4 the data were collected from two samples 1) the Virginia 30,000 Health and Life-Style Survey for Twins recruited from the Virginia population based twin registry and the American Association of Retired Persons (Eaves et al. 1999) and 2) the volunteer Australian Twin Registry Health and Lifestyles questionnaire (Martin et al. 1986;

Martin et al. 1987; Eaves et al. 1989; Truett et al. 1992).[119] The methods are the same utilized in previous chapters and the analyses were completed concurrently with our initial examination of political attitudes in chapter 4.[120]

Results

Sex Differences

The original analyses utilized by Alford et al. (2005) relied on polychoric correlation and did not test the variance components (ACE) for significant differences due to sex. In this analysis, the separate path coefficients for males and females were examined and compared to the full ACE model where the variance components for females and males are equated in order to test whether sex specific differences in the magnitude of the variance components provide a better model fit than without sex differences.

Univariate models containing additive genetic, common environmental and unique environmental variance components were fitted to determine which model best explains each political attitude individually, exactly the same as in chapter 4. Several models were examined, however for this examination the focus is on testing to see if we can equate the variance components for males and females to determine if sex difference exist in the estimates. Tables 1 and 2 provides the results of the re-analyses of the US sample and comparisons with the original Alford et al. (2005) results.

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[119] Sampling technique, response rates, demographics, zygosity, measures, and more specific information regarding these data are available in chapter 4 and 5.

[120] As noted, chapter 4 did not explain the findings in regards to sex differences.

Table 6.1 (US) Standardized Variance Components (95% CI) Sex Limitation Model Fitting for Political Attitudes

		Parameter Estimates							
		Females			Males				
	Model^a	a^2	c^2	e^2	a^2	c^2	e^2	Δa^2	Δc^2
Live Together	ACE^{bc}	.51 (.41-.68)	.16 (.10-.24)	.33 (.30-.37)	0 (.00-.34)	.48 (.21-.54)	.52 (.52-.58)	.51	.32
Religiosity-2	ACE^{bc}	.56 (.35-.66)	.19 (.08-.39)	.25 (.21-.29	.22 (.00-.57)	.36 (.05-.59)	.41 (.32-.50)	.34	.17
Busing	ACE^{b}	.31 (.16-.31)	.09 (.08-.20)	.60 (.55-.65)	.12 (0-.40)	.30 (.06-.45)	.58 (.50-.66)	.19	.21
Divorce	ACE^{bc}	.25 (.16-.29)	.23 (.08-.38)	.52 (.47-.57)	.42 (.31-.42)	0 (.00-.07)	.57 (.53-.65)	.17	.23
School Prayer	ACE^{b}	.32 (.16-.48)	.37 (.22-.51)	.31 (.27-.36)	.47 (.22-.62)	.21 (.09-.41)	.32 (.26-.40)	.15	.16
Capitalism	AE^{b}	.47 (.43-.52)	-	.53 (.48-.57	.61 (.54-.67)	-	.39 (.33-.46)	.14	.00
Abortion	ACE^{bc}	.26 (.12-.41)	.41(.27-.53)	.33 (.29-.37)	.38 (.16-.51)	.19 (.10-.37)	.43 (.36-.50)	.12	.22
Foreign Aid	ACE^{b}	.40 (.29-.45)	.01 (.00.-10)	.59 (.55-.64)	.31 (.08-.49)	.11 (.00-.31)	.58 (.51-.66)	.09	.10
Women's Lib	ACE^{bc}	.34 (.18-.49)	.18 (.05-.18)	.48 (.44-.53)	.31 (.23-.39)	0 (.00-.03)	.69 (.61-.76)	.03	.18
Religiosity-3	ACE^{bc}	.48 (.32-.67)	.26 (.09-.41)	.25 (.22-.29)	.47 (.00-.65)	.18 (.04-.56)	.35 (.35-.45)	.01	.08
Censorship	AE^{b}	.38 (.33-.42)	-	.62 (.58-.67)	.39 (.35-.47)	-	.61 (.53-.69)	.01	.00
Death Penalty	ACE^{bd}	.35 (.22-.48)	.21 (.10-.31)	.44 (.40.-48)	.35 (.22-.48)	.21 (.10-.31)	.44 (.40.-48)	.00	.00
Pacifism	AE^{bd}	.31 (.27-.35)	-	.69 (.65-.73)	.31 (.27-.35)	-	.69 (.65-.73)	.00	.00
Segregation	AE^{bcd}	.37 (.32-.37)	-	.63 (.59-.68)	.37 (.32-.37)	-	.63 (.59-.68)	.00	.00
Draft	AE^{bd}	.37 (.32-.41)	-	.63 (.60-.68)	.37 (.32-.41)	-	.63 (.60-.68)	.00	.00
X-Rated	AE^{bcd}	.51 (.47-.56)	-	.49 (.46-.54)	.51 (.47-.56)	-	.49 (.46-.54)	.00	.00
Modern Art	AE^{bcd}	.40 (.36-.43)	-	.60 (.57-.64)	.40 (.36-.43)	-	.60 (.57-.64)	.00	.00
Moral Majority	AE^{bd}	.42 (.38-.47)	-	.58 (.53-.62)	.42 (.38-.47)	-	.58 (.53-.62)	.00	.00
Property Tax	AE^{bd}	.42 (.41-.46)	-	.58 (.58-.63)	.42 (.41-.46)	-	.58 (.58-.63)	.00	.00
Socialism	AE^{bd}	.38 (.34-.38)	-	.62 (.58-.66)	.38 (.34-.38)	-	.62 (.58-.66)	.00	.00
Immigration	AE^{bd}	.46 (.46-.49)	-	.54 (.51-.54)	.46 (.46-.49)	-	.54 (.51-.54)	.00	.00
Party ID	CE^{bcd}	-	.81 (.78-.84)	.19 (.16-.22)	-	.81 (.78-.84)	.19 (.16-.22)	.00	.00
Astrology	AE^{b}	.47(.43-.47)	-	.53 (.48-.57)	.47 (.39-.54)	-	.53 (.46-.61)	.00	.00
Gay Rights	ACE^{bd}	.34 (.24-.45)	.25 (.22-.34)	.41 (.39-.45)	.34 (.24-.45)	.25 (.22-.34)	.41 (.39-.45)	.00	.00
Military Drill	AE^{bd}	.36 (.31-.40)	-	.64 (.63-.69)	.36 (.31-.40)	-	.64 (.63-.69)	.00	.00
Unions	AE^{bd}	.41 (.36-.46)	-	.59 (.54-.64)	.41 (.36-.46)	-	.59 (.54-.64)	.00	.00
Fed Housing	AE^{b}	.41 (.36-.46)	-	.59 (.54-.64)	.41 (.36-.46)	-	.59 (.54-.64)	.00	.00
Nuclear Power	AE^{bd}	.34 (.30-.39)	-	.65 (.61-.65)	.34 (.30-.39)	-	.65 (.61-.65)	.00	.00

Note: (a) Only best fitting models shown, Thresholds Corrected for Age. (b) Equated Thresholds for MZ and DZ pairs (no violation of EEA). (c) Equated Thresholds for Males and Females, MZ and DZ twins. (d) Equated VC for Males and Females.

Table 6.2 (AUS) Standardized Variance Components (95% CI) Sex Limitation Model Fitting for Political Attitudes

		Parameter Estimates							
		Females			Males				
	Model	a^2	c^2	e^2	a^2	c^2	e^2	Δa^2	Δc^2
Censorship	ACE[b]	.36 (.22-.44)	0 (.00-.10)	.64 (.56-.73)	.14 (.00-.45)	.30 (.01-.49)	.58 (.47-.68)	.22	.30
Abortion	ACE[bc]	.42 (.25-.60)	.21 (.05-.35)	.37 (.32-.43)	.42 (.25-.60)	.21 (.05-.35)	.37 (.32-.43)	.00	.00
Death Pen	AE[bd]	.55 (.50-.60)	-	.45 (.40.50)	.55 (.50-.60)	-	.45 (.40.50)	.00	.00
Divorce	ACE[bcd]	.20 (.01-.39)	.22 (.06-.37)	.58 (.52-.65)	.20 (.01-.39)	.22 (.06-.37)	.58 (.52-.65)	.00	.00
Gay Rights	ACE[bd]	.37 (.20-.55)	.15 (.01-.30)	.47 (.42-.53)	.37 (.20-.55)	.15 (.01-.30)	.47 (.42-.53)	.00	.00
Immigration	ACE[bd]	.37 (.20-.53)	.12 (.00-.26)	.51 (.45-.56)	.37 (.20-.53)	.12 (.00-.26)	.51 (.45-.56)	.00	.00
Modern Art	AE[bcd]	.42 (.36-.48)	-	.58 (.52-.64)	.42 (.36-.48)	-	.58 (.52-.64)	.00	.00
Nuclear Pow	AE[bd]	.40 (.34-.45)	-	.60 (.55-.66)	.40 (.34-.45)	-	.60 (.55-.66)	.00	.00
Religiosity	ACE[bcd]	.37(.21-.54)	.28 (.13-.41)	.35 (.30-.40)	.37(.21-.54)	.28 (.13-.41)	.35 (.30-.40)	.00	.00
Socialism	AE[bcd]	.39 (.34-.44)	-	.61 (.56-.66)	.39 (.34-.44)	-	.61 (.56-.66)	.00	.00
Unions	AE[bcd]	.45 (.40-.50)	-	.55 (.50-.60)	.45 (.40-.50)	-	.55 (.50-.60)	.00	.00

Note: (a) Only best fitting models shown, Thresholds Corrected for Age. (b) Equated Thresholds for MZ and DZ pairs (no violation of EEA). (c) Equated Thresholds for Males and Females, MZ and DZ twins. (d) Equated VC for Males and Females.

Analyses conducted for each of the individual political attitudes do not confirm Alford et al.'s initial findings. Using structural equation modeling 10 of the 28 items examined provided significant sex differences in the additive genetic variance (Living Together, Religiosity-2, Busing, Divorce, School Prayer, Capitalism, Abortion, Foreign Aid, Women's Lib, Religiosity-3 and Censorship). Alford et al. (2005) assumed the variance components could be equated for every item. While some differences in the additive genetic component between the sexes were relatively minor (.03 for Women's Lib), items such as Church Attendance, Busing, Divorce, School Prayer find at least .15 difference and living together has > .50 additive genetic component in females versus that of males.[121]

The available Australian subset examined only 11 of the items, but interestingly, only attitudes on Censorship provided a significant difference in the additive genetic component between males and females (.22) compared to that of the US sample (.01). Since only 11 of the items were available in the AU data we cannot make a full

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[121] The findings presented here also differ from Martin et al (1986) who analyzed males and females separately.

comparison of the US an AUS sample, however items such as Abortion and Divorce while showing a strong genetic differences between the sexes in the US sample, presented no such difference in AU sample. These differences leave us to find some explanation as to why people who reside in the US and in Australia have different genetic pressure or heritable tendencies.

Who is Correct? Social Science of Biology? Where do Differences Come From?

Clearly not only do genes influence behaviors, but the importance of genetic influences are often very different between the sexes. Sex matters. The first hypothesis assumed by the social science community, that no genetic differences between males and females regarding political behavior exists, is not confirmed by the data here. Rather, there is very strong evidence that a significant portion of the variance in attitude difference between males and females is genetic, confirming the assumptions of biologists. Furthermore, the second portion of the social science hypotheses, that females are more affected by their common environment than males also does not hold. While women have a larger C component for Divorce, School Prayer, Women's Lib and Abortion, men have a larger C component for Living Together, Religiosity, Busing and Foreign Aid. Even more important is the finding that with the exception of three items (School Prayer, Abortion and Party ID), females unique experience was a much greater factor than their common environment. In effect, socialization for women is not nearly as great a source of variance in general as proposed by the current literature. While C matters slightly more to women than men, it does not matter nearly as much more as assumed in the traditional literature.

The variance due to unique environment is equally telling. Unique environment accounted for more of the variance in females than males in only two items (capitalism and foreign aid), while unique environment accounted for more of the variance in males than females in 5 items (living together, religiosity, divorce, abortion, and women's liberation).

While the genetic differences found between the sexes in political attitudes confirms the first part of the evolutionary hypotheses, the second part of the evolutionary hypotheses cannot be confirmed. I did not find that women have stronger additive genetic components for political items that address those in need, evoke emotional responses, and build stronger domestic support systems or tap into an ethic of care. Nor did I find that females have lower additive genetic components for the use of force and power issues; or that men have stronger additive genetic components for most political items.

Looking back at Tables 1 and 2 we do not find any discernable pattern. Women do have greater additive genetic components for Living Together, Religiosity, Busing, Foreign Aid and Women's Lib, appearing to make a weak case that women's biology influences their positions on issues of empathy, care and social relationships. However males have stronger additive genetic components on issues such as Divorce, School Prayer, Capitalism and Abortion which may also be argued to be family oriented and empathetic. Yet one could make the argument that these issues are about dominance and reproductive strategies as well. As feared and suspected in Chapter 2, in both cases we are left with speculation. In the Australian sample women had a stronger additive genetic component for Censorship, opposite to what one might infer based upon the social dominance angle provided by evolutionary scholars.

Table 3 provides the variance component estimates (ACE) for females ordered by the strongest additive genetic component to the weakest. There is still no clear pattern that displays a stronger genetic effect for empathy or care issues versus power or mating issues. While a weak pattern exists with Religiosity, X-Rated, and Living Together at the top, items such as Property Tax, Capitalism, Modern Art, Censorship and the Draft rank much stronger than Prayer Pacifism, Busing and Abortion.

Table 4 provides the variance component estimates (ACE) for males ordered by the strongest additive genetic component to the weakest. While Capitalism and X-Rated rank the highest and could thus be interpreted as Power and Mating issues matching evolutionary thoughts, in females we interpreted X-Rated as a procreation or empathy issue; so which are they? Power or empathy issues? Can we interpret them as power for males and empathy for females just to confirm the hypotheses? Certainly not; rather we can only speculate on the second part of the evolutionary hypotheses. Furthermore Astrology and School Prayer have a much more pronounced additive genetic component than the Draft, the Death Penalty or Military Drill, presumably male power items.

Table 6.3 Table 6.4 Standardized Variance Components (95% CI) Sex Limitation for Political Attitudes (Females)

		Females		
	Model[a]	a^2	c^2	e^2
Religiosity-2	ACE[bc]	.56 (.35-.66)	.19 (.08-.39)	.25 (.21-.29
X-Rated Movies	AE[bcd]	.51 (.47-.56)	-	.49 (.46-.54)
Living Together	ACE[bc]	.51 (.41-.68)	.16 (.10-.24)	.33 (.30-.37)
Religiosity-3	ACE[bc]	.48 (.32-.67)	.26 (.09-.41)	.25 (.22-.29)
Astrology	AE[b]	.47(.43-.47)	-	.53 (.48-.57)
Capitalism	AE[b]	.47 (.43-.52)	-	.53 (.48-.57
Immigration	AE[bd]	.46 (.46-.49)	-	.54 (.51-.54)
Property Tax	AE[bd]	.42 (.41-.46)	-	.58 (.58-.63)
Moral Majority	AE[bd]	.42 (.38-.47)	-	.58 (.53-.62)
Unions	AE[bd]	.41 (.36-.46)	-	.59 (.54-.64)
Federal Housing	AE[b]	.41 (.36-.46)	-	.59 (.54-.64)
Modern Art	AE[bcd]	.40 (.36-.43)	-	.60 (.57-.64)
Foreign Aid	ACE[b]	.40 (.29-.45)	.01 (.00.-10)	.59 (.55-.64)
Socialism	AE[bd]	.38 (.34-.38)	-	.62 (.58-.66)
Censorship	AE[b]	.38 (.33-.42)	-	.62 (.58-.67)
Draft	AE[bd]	.37 (.32-.41)	-	.63 (.60-.68)
Segregation	AE[bcd]	.37 (.32-.37)	-	.63 (.59-.68)
Military Drill	AE[bd]	.36 (.31-.40)	-	.64 (.63-.69)
Death Penalty	ACE[bd]	.35 (.22-.48)	.21 (.10-.31)	.44 (.40.-48)
Nuclear Power	AE[bd]	.34 (.30-.39)	-	.65 (.61-.65)
Gay Rights	ACE[bd]	.34 (.24-.45)	.25 (.22-.34)	.41 (.39-.45)
Women's Lib	ACE[bc]	.34 (.18-.49)	.18 (.05-.18)	.48 (.44-.53)
School Prayer	ACE[b]	.32 (.16-.48)	.37 (.22-.51)	.31 (.27-.36)
Pacifism	AE[bd]	.31 (.27-.35)	-	.69 (.65-.73)
Busing	ACE[b]	.31 (.16-.31)	.09 (.08-.20)	.60 (.55-.65)
Abortion	ACE[bc]	.26 (.12-.41)	.41(.27-.53)	.33 (.29-.37)
Divorce	ACE[bc]	.25 (.16-.29)	.23 (.08-.38)	.52 (.47-.57)
Political Affiliation	CE[bcd]	-	.81 (.78-.84)	.19 (.16-.22)

Note: (a) Only best fitting models shown, Thresholds Corrected for Age. (b) Equated Thresholds for MZ and DZ pairs (no violation of EEA). (c) Equated Thresholds for Males and Females, MZ and DZ twins. (d) Equated VC for Males and Females.

Table 6.4 Standardized Variance Components (95% CI) Sex Limitation Model Fitting for Political Attitudes (US Males)

		Females		
	Model[a]	a^2	c^2	e^2
Capitalism	AE[b]	.61 (.54-.67)	-	.39 (.33-.46)
X-Rated Movies	AE[bcd]	.51 (.47-.56)	-	.49 (.46-.54)
Astrology	AE[b]	.47 (.39-.54)	-	.53 (.46-.61)
School Prayer	ACE[b]	.47 (.22-.62)	.21 (.09-.41)	.32 (.26-.40)
Religiosity-3	ACE[bc]	.47 (.00-.65)	.18 (.04-.56)	.35 (.35-.45)
Immigration	AE[bd]	.46 (.46-.49)	-	.54 (.51-.54)
Property Tax	AE[bd]	.42 (.41-.46)	-	.58 (.58-.63)
Moral Majority	AE[bd]	.42 (.38-.47)	-	.58 (.53-.62)
Divorce	ACE[bc]	.42 (.31-.42)	0 (.00-.07)	.57 (.53-.65)
Unions	AE[bd]	.41 (.36-.46)	-	.59 (.54-.64)
Federal Housing	AE[b]	.41 (.36-.46)	-	.59 (.54-.64)
Modern Art	AE[bcd]	.40 (.36-.43)	-	.60 (.57-.64)
Censorship	AE[b]	.39 (.35-.47)	-	.61 (.53-.69)
Socialism	AE[bd]	.38 (.34-.38)	-	.62 (.58-.66)
Abortion	ACE[bc]	.38 (.16-.51)	.19 (.10-.37)	.43 (.36-.50)
Draft	AE[bd]	.37 (.32-.41)	-	.63 (.60-.68)
Segregation	AE[bcd]	.37 (.32-.37)	-	.63 (.59-.68)
Military Drill	AE[bd]	.36 (.31-.40)	-	.64 (.63-.69)
Death Penalty	ACE[bd]	.35 (.22-.48)	.21 (.10-.31)	.44 (.40.-48)
Nuclear Power	AE[bd]	.34 (.30-.39)	-	.65 (.61-.65)
Gay Rights	ACE[bd]	.34 (.24-.45)	.25 (.22-.34)	.41 (.39-.45)
Pacifism	AE[bd]	.31 (.27-.35)	-	.69 (.65-.73)
Women's Lib	ACE[bc]	.31 (.23-.39)	0 (.00-.03)	.69 (.61-.76)
Foreign Aid	ACE[b]	.31 (.08-.49)	.11 (.00-.31)	.58 (.51-.66)
Religiosity-2	ACE[bc]	.22 (.00-.57)	.36 (.05-.59)	.41 (.32-.50)
Busing	ACE[b]	.12 (0-.40)	.30 (.06-.45)	.58 (.50-.66)
Living Together	ACE[bc]	0 (.00-.34)	.48 (.21-.54)	.52 (.52-.58)
Political Affiliation	CE[bcd]	-	.81 (.78-.84)	.19 (.16-.22)

Note: (a) Only best fitting models shown, Thresholds Corrected for Age. (b) Equated Thresholds for MZ and DZ pairs (no violation of EEA). (c) Equated Thresholds for Males and Females, MZ and DZ twins. (d) Equated VC for Males and Females.

Biological male and female differences exist, and they do in fact influence behavior based on sex. However while certain aspects of the evolutionary psychology literature offer interesting hypotheses they are based on speculative presumptions at best, leaving us with no definitive means to test. While the cultural and biological theorists both agree that there are basic differences in the outlooks and attitude formation of men and women, the source of these differences is the area of disagreement. Considering the findings above and the literature reviewed, this chapter offers some important insight. In short the biologists, not the evolutionary psychologists, or the social scientists are correct. The environment is not the single source for behavior, nor can we show that the source of all modern behaviors are based on presumptions about primitive man. We can say that empirical evidence provided here shows that there are multiple sources for political behavior, and the difference in political behavior between men and women is not just societal based, or environmentally driven. It is also biologically influenced.

Conclusion

Inherited traits matter for political behaviors, and in part one's sex makes a difference in how much they matter for certain specific attitudes. Structural equation modeling shows there is a difference in the additive genetic component of political attitudes between men and women. However whether these differences are connected to evolutionary foundations for male and female behavior is speculative at best.

Human behavior is partially guided by our biological sex, but this does not mean we should interpret differences in behavior as a predetermined stimulus-repose mechanism based upon sex; quite the contrary, the impact of the environment is equally strong or stronger and significantly different between men and women. As such we must incorporate the environmental, social, biological and heritable components and realize that each contains a certain weight in different circumstances for different peoples highly dependent upon sex.

Chapter 7 - Conclusion

> "Heredity and environment are so intertwined that it is impossible to disentangle them completely. Genetic factors exert their influence on an organism that is in a particular environment, so the final product is inevitably a combination of biological and experiential factors" (Olson et al. 2001).

The question I pose to the reader, is can we as political scientists afford to believe all of our behavior can be explained by familial socialization, rational action and free will? Or is there room for biological factors to help explain part of the variance in political behavior? Should we consider genes as a source for preferences that remain "given" in typical social science studies? Can political science begin to develop an explanatory theory of human behavior of its own, integrating the biological and psychological factors with our rich literature examining rational action, personal experience, societal influence and familial socialization, rather than borrowing from the discards of economics, sociology, psychology and anthropology? By looking beyond pure rational choice or behavioral explanations, as science has advanced our ability to find inherent differences in human behavior, we can define our discipline as one of science, and not sociological determinism.

As evolution is ultimately rational, and human biological mechanisms are rational, it is quite possible that rational choice theorists are correct that we act rationally, but they simply have the source of rational preferences wrong and make incorrect assumptions about the process of rationality. It is very likely that we are hard wired for rationally and this rationality is not consciously motivated or cognitively driven as traditional theorists posit. Rather, biological, genetic and inherited traits are the source for rational preferences and evolution has ensured that our internal processes motivate us to act in a rational manner. Combine this source of preferences with rational choice and unique experience including behavioralist notions of socialization and we have a more complete theory of political behavior.

Although the coefficients presented in chapters 4, 5 and 6 show that heritable and environmental factors combined equate to 100 percent of behavior, in reality the formula is much more complicated. In comparison to Mother Nature, we have only rudimentary tools to base our conclusions on. Environment plus genetics is not like baking a cake: 1 pt flour, 1 egg and some sugar can be measured in specific quantities, human behavior cannot. Furthermore, for the cake all of the ingredients are known; for human behavior, we are only beginning to find out what is involved. I caution the reader to understand that using the simple tools we have, I can say certain behaviors have a strong additive genetic component, but the coefficients presented are not absolute, only relative to the items measured, in the population sampled and for the time sampled. While one's genes are static over one's life, genes are not static over generations of life.

More importantly, are the next steps. While classical twin and family designs can give estimates on the genetic and environmental components of certain behaviors or attitudes, they cannot explain why a specific individual has a certain attitude or explain what mechanisms are responsible for the genetic component. Twin studies tell us whether or not to look further, but they are not the "end game." Heritability estimates cannot determine which group of genes, chemical reactions or internal mechanisms influence behavior or how interactions with environment affect certain behaviors at an individual level. I like to think of the twin design as a water rod. Used right, it will tell you where to drill down deeper, but by itself it cannot get to the water. To find the "water" so to speak, we need to begin gene association and linkage studies.[122]

This consideration requires careful thought. In traditional political research we are mainly speaking about "means" and generalities. We use individual level inferences to make aggregate findings. Biometrical theory changes this dramatically. We can actually provide prospective models when including genes and environmental stimuli. We can

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[122] Offering an introduction to gene association is beyond the scope of this work. However numerous findings report specific gene/behavior relationships. For example, over the past 10 years, examinations of the serotonin transporter polymorphism's (5-HTTLPR) affect on depression have produced very promising findings; individuals exposed to environmental stress with a certain genotype of the serotonin polymorphism (short-short allele pair) have been found to be much more likely to be depressed (Caspi et al. 2003; Gillespie et al. 2005; Surtees et al. 2006; Wilhelm et al. 2006).

make individual level predictions – a radical departure from the tools most social scientists employ. Do not mistake this to mean there is “a” gene for “a” behavior. The process from genes to human action is complicated and convoluted and is the sum of all genes and environmental determinants.

Therefore, it is likely that this study raises more questions than it answers. The demonstration that genes significantly contribute to differences in political behavior implies little about the modifiability of attitudes or about the theoretical “rightness” or biological value of the genetic component of political attitudes. From a biological perspective, the past and future adaptive significance of a particular attitude is irrelevant. Does the additive genetic component for certain political attitudes require society to act or denounce one trait over the other? Is diversity in attitudes adaptive in an increasingly diverse environment? Does any portion of the genetic studies of political attitudes have normative implications? These I do not know. All that I can claim in these results is that a genetic component for political attitudes exists and these components are passed down from our ancestors.

Using designs similar to ones used here in an attempt to explain why people do what they do will present problems for the discipline. The social sciences’ typical research agenda may be perceived as “watered down” once genetic components are introduced, particularly if genetics can account for over 50 percent of the variance as found in this study as well as others (Martin et al. 1986; Eaves et al. 1999; Alford et al. 2005; Hatemi et al 2007). Previous findings based on environmental factors may be deemed less powerful; thus some scholars may reject adding a biological component out of self-interest (maybe a genetic component as well?). This may be particularly true for those whose lifelong research agenda is based on purely environmental factors as most political scientists are, which may likely result in those scholars being very reluctant to look in this new direction or to review articles that do so. It may be perceived that introducing genetics forces us as a community to learn new tools and answer new questions, and may invalidate our previous findings.

However this does not and will not always have to be the case. Biology gives us a means to validate our traditional works as well; particularly by providing an outside control such as genes to falsify our presumptions, as we found in Chapter 5. There need not be an adversarial relationship between the hard and soft sciences, or between biology and environment. There is no environment without biology and there is no biology without environment. Whereas environmental approaches provide the conceptual tools for understanding human behavior in context, biology provides the tools to study the machinery behind the decision making. The relationship is a cooperative one. Adding a bottom up approach, not replacing an environmental approach, allows us to look at new areas; we may find nothing, and we may find more than we thought, but by not looking at all, we will never know.

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