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The Controversy of Nature, Nurture, and Control

Alyssa LaGrone
Trinity University, alagrone@trinity.edu

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We like to believe that we have control over the person we are and the person we become, as this is a comforting, safe, and empowering conviction. However, many fail to accept the uncomfortable reality that factors outside our control, such as our genes, environments, and cultures extensively influence our identities and life outcomes. The consequential question regarding how much power we have over ourselves, our paths, and our futures have circulated among the minds of scholars, researchers, and the curious for decades in their quest for a definitive truth. In their attempts to answer this question, many have turned to the longstanding controversial nature-nurture debate, which explores whether nature (i.e. our genetic makeup, inherent traits, etc) or nurture (i.e. environment, upbringing, etc) is more influential in determining our individual choices, personas, and life trajectory. I argue that the nature aspect has been overlooked in the public sphere and that we need to be cognizant of the downstream social consequences that arise as a result. Only by integrating together the interaction between nature and nurture can we learn how to understand, approach, and ultimately correct social injustices.

The nature-nurture debate is commonly broken down into two, often opposing, arguments. Supporters of the nurture argument, known as empiricists or environmentalists, argue that human characteristics are not inherited from an individual's parents but instead that people are blank slates influenced primarily by the environment (Mcleod). Meanwhile, supporters of the

nature argument, known as nativists, believe that our behavior, personality traits, and intelligence are inherent and solely determined by heredity (Mcleod). While many are quick to pit nature and nurture against each other, study after study has revealed a "dynamic interplay between gene action and environmental processes" that continuously shape us throughout life (Institute of Medicine and National Research Council). While both nature and nurture have been established to contribute to individual differences, many overlook the undeniably significant degree to which genetic factors shape us. The most striking evidence comes from twin, adoption, and Genome-wide association study (GWAS) results, which highlight the importance of genetic and environmental influences and thus laid the basis for the field of human behavioral genetics (Friedman). Taken together, twin, adoption, and GWAS studies consistently suggest that genetic factors have a greater influence than many realize or want to accept in shaping our personhood. It is crucial that we understand our innate biological and genetic differences as ignorance of these facts can lead to downstream consequences in the ways we view and interact with the world. By 'misdiagnosing' social problems as emerging only from 'nurture' factors that humans control, we waste valuable time and energy hating and blaming others for imperfections outside our control. By understanding the uncontrollable genetic aspects of humanity, as a whole and ourselves, we can better understand why humans are the way they are, and most importantly, learn to coexist together.

One of the most common and long-standing methods for addressing the nature-nurture question comes from adoption and twin studies, which provide valuable and often surprising evidence differentiating the influences of genes and the environment. Adoption studies compare the similarity between an adoptee and their biological versus adoptive relatives, or the similarity between biological relatives of affected adoptees with those of unaffected or control adoptees

(Lehner). Adoption studies are one of the most powerful and widely cited tools used for "evaluating the interactions of genetic and environmental factors" in eliciting human characteristics and disorders (Cadoret). Likewise, twin studies are a unique type of epidemiological study where data is collected from monozygotic (MZ) twins and dizygotic (DZ) twins (Felson). MZ twins, also known as identical twins, develop from a "single sperm fertilizing a single egg," which divides into "two separate cell masses" during the "first two weeks of development," resulting in essentially twin clones (Guo). On the other hand, DZ twins, known as fraternal twins, develop when "two eggs are each separately fertilized by different sperm," which results in them having "on average, half their genes in common" (Guo). Such studies involving the "statistical comparisons of identical and fraternal twins" and adoptees are some of the most "prominent method[s] to determine heritability" in humans (Moore). As a result, twin and adoption studies have been used for decades to examine the nature-nurture relationship and its implications on the genetic factors influencing our lives.

Despite their efficiency in measuring nature and nurture influences, some critics argue that the findings of twin and adoption studies are meaningless, noting their flawed methodology, adverse implications, and societal consequences. One of the most common criticisms traditional twin studies face is their reliance on the equal environments assumption which states that "MZ and DZ pairs are equally exposed" to similar "shared environmental factors" (Harrop). Critics argue that identical twins may be treated more alike than fraternal twins due to their already similar appearance and mannerisms. For example, identical twins are more likely than fraternal twins to dress similarly, which may result in similar treatment (Guo). This identical treatment could potentially shape identical twins to be more similar than fraternal twins, resulting in scientists mistakenly attributing the effects to genes when they actually arise from differences in

treatment (Guo). However, similar treatment of identical twins does not automatically discredit twin studies as the important issue is instead whether the treatment of identical twins affects a specific outcome. The equal environments assumption is not relevant regarding conclusions about unrelated conditions as similar styles may not, for example, affect depression. This would instead suggest the possibility of a correlation between genes and depressive disorders. Furthermore, due to their infrequency, twin studies often rely on voluntary participation, which leads to "volunteer bias or recruitment bias" (Sahu). These flawed samples can consequently lead to the "over-inclusion of identical and female twins" (Sahu). This is a prominent issue in twin studies, as finding ideal cases of "identical twins separated at birth and brought up in separate environments" is exceedingly difficult to find and replicate (Guo). Similarly, adoption studies are becoming less feasible methods for analyzing genetic and environmental influences as the frequency of adoptions in the United States continues to diminish (Lehner). One solution regarding twins, however, has been to study twins who were raised together and compare the experiences of identical twins and fraternal twins as these identical versus fraternal twin comparison results can be used to estimate the degree of variation in a trait due to gene variations (known as heritability), shared environments, and other unshared environmental factors (Guo). Nonetheless, critics argue that this unavoidable bias has two major consequences. First, the lack of randomization prevents the study results from being "directly generalized to the general population" (Sahu). However, according to the National Longitudinal Study of Adolescent Health and Findings, twins and adoptees are not systematically different from the "general population" of non-twins and non-adoptees on various "measures of behavior and development," which suggests that evidence from twin and adoption based research are likely generalizable (Barnes). On the other hand, critics argue that this selection bias can lead to an "overestimation

of the heritability of the trait or condition under study" (Sahu). As a result, findings from these studies are often "misunderstood, misinterpreted, and blown out of proportion" by both the media and published scientists (Sahu). This can reinforce various false impressions and assumptions, such as the common false notion that "some physical and personality traits" can be passed "directly from parent to child" through DNA (Moore). While some studies may overemphasize the influence of genetics, the public will always develop false impressions and conclusions from valid publications and skew the data in a way favorable to their cause; it's inevitable. While imperfect, classical twin and adoption studies have effectively established the heritability (amount of phenotypic variation in a population that is attributable to individual genetic differences) of human behavioral traits in a way that is consistent, reliable, and powerful in its discovery that all behavior, to a certain degree, is partially heritable (Taylor and Johnson).

While we can point to the nature of twin and adoption studies, it is truly the stories these studies tell, especially regarding twins, that have shaped our modern understanding of genetic influences. One such story follows the narratives of Oskar and Jack, who were part of Thomas Bouchard's Minnesota Study of Twins Reared Apart (MISTRA). During this longitudinal case study, Bouchard and his colleagues psychologically and physiologically evaluated more than 100 sets of twins or triplets who were separated early in life and raised in different environments to study individual differences in human behavior (Bouchard). One of these twin sets, Oskar and Jack, had completely different upbringings, cultures, and environments, yet demonstrated uncanny similarities. Separated at six months, Oskar was taken to Germany with his mom while Jack stayed with his father in Trinidad. Growing up, differences became apparent as Oskar spoke German and became a Nazi while Jack spoke Yiddish and embraced his Jewish heritage. When they met each other for the study, both showed a similar fashion style, each wearing

wire-rimmed glasses, mustaches, and two-pocket shirts with epaulets. Most notable were their similar mannerisms and preferences for spicy foods, sweet liquors, dipping buttered toast in coffee, flushing toilets before and after use, talent for sports, difficulty with math, falling asleep in front of the TV, fake sneezing in awkward situations, and wearing rubber bands on their wrist (Alfred). While some may attribute these similarities to confirmation bias, equally unique similarities were found across the reared-apart twins in the MISTRA. The study found that reared-apart identical twins had the same chance of being similar to twins who were raised together, which suggests that "genetic factors have a large influence on behavioral habits" and individual differences (Bahjat). Another shocking narrative was shown in the documentary "Three Identical Strangers," which follows the lives of three triplets, Robert Shafran, Eddy Galland, and David Kellman, who were separated at birth and purposefully placed into households of differing socioeconomic statuses and parenting styles as part of an unethical scientific study examining the nature-nurture debate. Despite their different childhoods, all of the triplets displayed uncanny similarities in appearance, personality, film preferences, sports, mannerisms, and mental health difficulties as they all suffered from depression, separation anxiety, and spent time in psychiatric hospitals as teenagers (Somarriba). These narratives show a shocking story of genetic similarities that I believe are too identical to be a coincidence. Studying these unique differences between and within twin pairs allow scientists to gain crucial insights regarding the influence of genes on our personality, behaviors, preferences, and individuality. However, these few extreme examples of twin narratives arguably only provide "single-case cherry-picked anecdotal stories" that "sell the false ideology of genetic (biological) determinism" (Joseph). I strongly disagree with genetic (biological) determinism, the notion that most human characteristics are determined by hereditary factors passed from parent to offspring

(Allen). I argue that these twin case studies do not endorse biological determinism, but instead, provide clear instances of biological forces influencing us amidst environmental pressures and circumstances. Nonetheless, science writer and MISTRA critic John Horgan argues that "these tales of separated twins" only serve as a "powerful rhetorical device" while "statistical analyses and heritability figures" are often disregarded (Joseph). As such, twin and adoption statistics, analysis, and studies must be discussed along with these idealized narratives.

Compared to individual case studies, there is a plethora of twin and adoption studies examining a variety of individual traits and conditions that all demonstrate a reliable and consistent genetic influence. Twin and adoption studies arguably provide some of the most reliable evidence that, "genes determine human traits and behavior" (Guo). Regarding lifestyle choices and actions, evidence suggests that genes influence factors such as parenting style, rate of accident occurrence in childhood, television-viewing habits, peer-group selection, the timing of first sexual intercourse, marital disruption, and educational and economic attainment (Guo). According to Behavioral Geneticists, Robert Plomin and his colleagues, even individual personality traits (measured by the 'Big Five' dimensions of personality: neuroticism, extraversion, openness, agreeableness, and conscientiousness) have a heritability measure of 0.43 which is considered a "significant effect" (Guo). There is however fluctuation in the heritability estimates of personality, as other studies have found that "human personality is 30–60% heritable" (Zwir). Social behavior has also been suggested to be biologically influenced, as a study with 3,795 twin pairs and 338 adoptees found medium to large effect sizes for genetic influences with approximately 50% of the variance in measures of antisocial behavior attributable to genetic effects (Mason & Frick). Furthermore, a study of 18,070 Swedish adoptees and additional adoption studies in Denmark and Norway found that genetic influences were the

most significant contributor to later criminal behavior, suggesting strong evidence for a genetic propensity for criminal behavior (Kendler). Adoption studies also suggest that social and political values may have a genetic basis as adopted kids are more politically similar to their biological parents than their adopted parents. Recent studies have even discovered that both actual voter turnout (not self-reported turnout) and strength of affiliation with a party (regardless of the particular party involved) are strongly heritable (Hatemi). While twin and adoption studies have demonstrated genetic influences on a variety of moderately controllable traits and behaviors, their findings extend even further as studies have suggested strong biological links to more arguably uncontrollable characteristics.

Most notably, twin studies have suggested a genetic influence on cognitive measures such as reading abilities, cognitive development, and cognitive ability. Cognitive ability has a heritability of 0.5 while our intelligence quotient (IQ) has a linear increase in heritability from "approximately 20% in infancy to 40% in adolescence and to 60% in adulthood" (Guo & Plomin). The influence of genes on IQ is further demonstrated when looking at the IQ correlation between different family members and their respective genetic similarities. As shown in Figure 1, individuals that are more genetically alike will have a higher correlation in their IQs (Arnett & Jensen). For example, MZ twins raised together have the highest IQ correlation

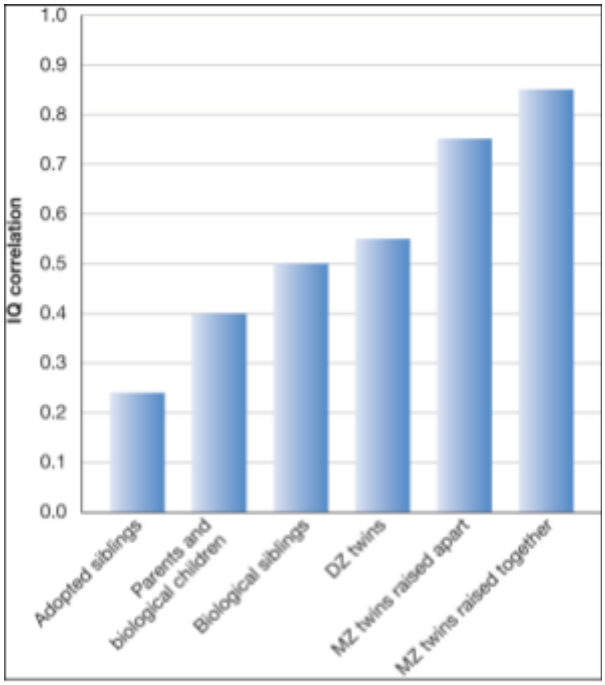

Figure 1: IQ Correlation with familial relationships (Arnett & Jensen).

(approximately 0.85) while adopted siblings have the lowest correlation (approximately 0.23). MZ twins, regardless of if they were raised together or apart, demonstrate the highest IQ correlation which can be traced to their identical genotype. DZ twins, who share half their genes, demonstrate a lower IQ correlation than their MZ counterparts (approximately 0.55). Parents and biological children demonstrate the second lowest IQ correlation (approximately 0.4) while adopted siblings have the lowest correlation (approximately 0.24). Despite adopted siblings having a relatively low IQ correlation, the environmental influence is apparent, as the correlation between two genetically unrelated children would ideally be zero. The same holds for the MZ twin correlations as MZ twins raised together have a higher IQ correlation than those raised apart, signifying both environmental and genetic influences on cognitive measures.

Similar evidence further suggests that genes influence additional uncontrollable traits that arguably have a greater impact on individual lives than mere IQ. While studies have shown that genes affect physical aspects such as height and weight, findings have also shown biological influences on more significant life conditions such as health disorders including manic-depressive psychosis, alcoholism, and schizophrenia (Guo). Twin studies have specifically established that manic-depressive psychosis, also referred to as bipolar disorder, is one of the most heritable medical disorders (Barnett). Additionally, a quantitative meta-analysis of twin and adoption studies of alcohol use disorder (AUD) found that AUD is approximately 50% heritable given the appropriate environmental conditions (Verhulst). Adoption studies have specifically demonstrated that genetic factors play a role in alcohol predispositions, use, and disorders as children of alcoholics who were adopted into another family exhibited more similar drinking patterns to their biological parents and full siblings, with similar heritability estimates between 50 and 60% (Miller). Another study containing 862 men and 913 women adopted by

non-relatives found evidence for a genetic predisposition to alcohol as both male and female adoptees were at greater risk to develop alcohol abuse if their biological, but not their adoptive, parents were alcoholics (Bohman). Furthermore, twin studies have demonstrated that "schizophrenia runs in families" as findings show that if one twin in an identical pair suffers from schizophrenia then the chance that the other twin will be schizophrenic is about 50% in MZ twins and about 17% in DZ twins (Guo). The gap between MZ and DZ twins provides strong evidence for the "existence of a genetic tendency" for schizophrenia (Guo). These health conditions, disorders, and risks are life-changing for millions as they easily spiral out of control, consequently altering the trajectory of people's lives, roles, and sense of self. By understanding our genetic differences and similarities, we can learn to acknowledge our innate lack of control, and in doing so, improve our health, lifestyle, and overall life trajectory.

Along with twin and adoption studies, GWAS are another common and reliable method for delving into the nature of genetic and biological influences, as they allow for the identification of genes associated with complex health conditions and traits. GWAS involves the rapid scanning of markers across complete sets of DNA, or genomes, of many people to identify "genetic variations associated with a particular disease" (National Human Genome Research Institute). GWAS most notably tests single nucleotide polymorphisms (SNPs), the most common type of genetic variation, which enable scientists to "pinpoint genes" that are likely "involved in disease development" (Uffelmann & Medline Plus). Despite this growing technology, some still point to its limitations to argue that GWAS is ineffective in measuring the biological linkage between genome and health conditions. For one, many traits are extremely polygenic, where thousands of variants each have a small effect on a trait, which challenges the ability to definitively pinpoint a specific underlying genetic cause for specific traits (Uffelmann).

Furthermore, while GWAS findings help clarify the genetic basis of diseases, they fail to address disease heritability as associated SNPs identified by most of these studies don't correlate with a familial risk for disease (Witte & Hoffmann). Similar to twin and adoption studies, many GWAS studies also focus on a specific population, which leads to concern that the samples and data used for GWAS are not representative of the global human population (Uffelmann). However, as of recently, more than 5,700 GWAS have been conducted with sample sizes extending far beyond a million participants, which has led to the study of more than 3,300 traits. With such a large and diverse sample size, the plethora of GWAS results can likely be concluded to be generalizable to the public. Nonetheless, with such a considerable group of participants, GWAS also raises ethical concerns related to data protection, equity issues, consent to future samples, storage and reuse of data, and privacy challenges with individual participants. Most importantly, along with twin and adoption studies, GWAS are susceptible to misinterpretations and skewed arguments that vouch for genetic determinism, the perception that traits are unavoidable and unalterable, which can lead to stigmas for patients, their family members, and societal perceptions and actions- or lack thereof. Despite its limitations, this state-of-the-art technology has provided the world with new scientifically supported evidence pointing to the heritability and genetic predisposition of adverse health conditions. Most notably, GWAS has successfully identified SNPs associated with several "complex conditions including diabetes, heart disease, Parkinson's disease, and Crohn's disease" (Medline Plus). Not only has GWAS identified specific genetically linked conditions, but studies have also identified SNPs associated with drug responses and environmental susceptibility(Medline Plus). This provides useful and practical information on potential preventative and post-treatments that can benefit millions of lives globally. As a result, GWAS results have a wide range of applications, such as gaining insight into a phenotype's underlying

biology, calculating genetic correlations, making clinical risk predictions, and inferring potential causal relationships between risk factors and health outcomes (Uffelmann).

Ultimately, there are and will always be things outside our control. Our genetic makeup, while seemingly insignificant, plays an immense role in shaping nearly all aspects of our identity and lives. As cognitive psychologist Steven Pinker puts it in his book The Blank Slate: The Modern Denial of Human Nature, "the possibility that heredity plays any role at all" in explaining "human thought and behavior…still has the power to shock" (Pinker). Many think that, "acknowledging human nature" means endorsing issues like "racism, sexism, war, greed, genocide, [and] neglect of children and the disadvantaged" (Pinker). In reality, understanding that biology and genetics shape the person we are and the person we become is simply acknowledging a fundamental truth. To clarify, I do not endorse the notion of genetic determinism. Our degree of control may be limited, but it is arguably not nonexistent. Nonetheless, ignorance of our innate differences provides an excuse to view the world in ways that put ourselves and others at fault for imperfections. Our tendency to 'misdiagnose' social problems as issues that stem only from nurture factors that humans control creates monsters that are quick to judge, hate, and blame others for things outside our control. By understanding the uncontrollable genetic aspects of humanity as a whole, and ourselves, we can better understand why humans are the way they are, and in doing so, learn to coexist with each other as we collectively journey towards a kinder and more empathetic world.

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