Chapter 1

Lemonade

Like ancient Gaul, the rest of this book is divided into three parts or modules as they will be referred to herein. The first module explains what genes are to the biologically impaired. No personal slight intended here. I wrote this book for college level academics whose main intellectual pursuits focus on social science. If you already know about biochemistry, cell biology, and molecular genetics, then the first module will bore you. Few of us social scientists have that background.

The second module—and the skimpiest one—deals with evolution and evolutionary psychology. The skimpiness should not underplay the importance of the topic. We have gained—and are still gaining—considerable amount of knowledge about evolution, but how this pertains to human behavior is much more nebulous compared to the hard science overviewed in the first module. Also, several topics, most notably anthropological genetics, cannot be presented in detail because of obvious space limitations.

The third module deals with the traditional behavioral genetics of individual differences. From our day-to-day interactions with relatives, friends and acquaintances, it is obvious that some people are more outgoing than others are. To what extent do genes contribute to these individual differences? This is the type of question to be discussed in this module. The largest fault in this module is its lack of integration with the first module. I offer no apologies for this shortcoming because the body of empirical data demand it—although there has been considerable research on the molecular genetics of human behavior, it is hard to find a body of consistent, replicable results to report. Rather than survey the most recent findings in this area and report that results have failed to replicate or that there are no data from other laboratories to assess replication, I have deliberately ignored this research. In future years, I hope that a body of well-replicated data emerges on the molecular genetics of, say, intelligence or schizophrenia that it can be carved into the stone of a textbook, much like the physical structure of DNA has been today. In the interim, we are left with one consistent theme that spans all three modules—lemonade. Let's discuss that for a minute.

Imagine that you are taking one of those standardized, multiple-choice, computer-scored tests that are part of the process of getting into college (e.g., the SAT), medical school (e.g., MCAT), or law school (e.g., LSAT). The following item appears in the test booklet:

According to the test instructions, you must fill in one and only one of the bubbles on the answer sheet. You have two different options. First, you could respond to the pragmatics of the test situation—to compete with all others taking the test, you must pick one and only one answer and hope that your choice matches the one on the scoring key. The second option requires more chutzpah—you recognize that the question is phenomenally stupid and protest the question to the test constructors. Lemonade is a compound, a solution, and an inextricable combination of lemon juice, water, and sweetener. It is something more than any one of its parts.

One can construct analogous multiple-choice questions on human behavior:

According to all the empirical scientific evidence on genes, and environment, and behavior, this question is as stupid as the one on lemonade. All substantive human behavior is multifactorial. That is, there is never a "single thing" responsible for individual differences in intelligence, extraversion, antisocial behavior, schizophrenia, interests in blood sports or any other substantive human behavior. Instead there are multiple causes, and as we shall learn later, genetics and the environment form a compound like lemonade.

1.1 Lemonade: Two laws

In 1957, Anne Anastasi initiated her presidential address to the American Psychological Association by stating

> "Two or three decades ago, the so-called heredity-environment question was the center of a lively controversy. Today, on the other hand, many psychologists look upon it as a dead issue. It is now generally conceded that both hereditary and environmental factors enter into all behavior. The reacting organism is a product of its genes and its past environment, while present environment provides the immediate stimulus for current behavior." (Anastasi, 1958, p. 197).

Carefully note the date of this quote—1958, over fifty years ago. Anastasi tried her best to drive a stake through the heart of the nature versus nurture debate, nail it securely into its coffin, and bury it so deep that it would never resurface. Despite her good intentions, the debate, like the evil vampire in a B movie, continually resurrects itself and intrudes upon rational discourse to an extent far beyond its true merit. Lemonade is not a philosophical statement. It is a concept about the relationship between genes and the environment that has—since Anastasi's time—been proved again and again in the empirical literature. I restate Anastasi's conclusion in terms of two fundamental laws about genes and behavior that have yet to be disproved. These are not new laws.

Anastasi stated them first. Almost twenty years later, they were repeated by Loehlin and Nichols (1976), and more recently by Turkheimer (2000). The first law states:

> *Environmental factors always contribute to individual differences in human behavior.*

Again, this law is not a philosophical position. It is a generalization from almost 100 years of empirical research on identical twins—for all behavioral traits studied thus far, identical twins are never identical in behavior. As a group, they may be very similar to each other, but the two members of every twin pair do not behave identically to each other. To say the same thing in statistical parlance, the correlation for identical twins on every behavioral measure studied thus far has always less than 1.0.

The second conclusion of the empirical data is:

> *Genes contribute to individual differences in almost every dimension of human behavior that has been studied thus far.*

Once again, this is not a philosophical postulate, but a generalization from decades of research. The dimensions of human behavior include intelligence (Bouchard, 1998; Bouchard and McGue, 1981b); the personality traits of extraversion, emotionality, openness to experience, agreeableness, cultural pursuits, and many others too numerous to name here (Eaves et al., 1989; Jang et al., 1996; Loehlin, 1992; Loehlin and Nichols, 1976; Tellegen et al., 1988); almost all patterns of vocational interests (Betsworth et al., 1994; Loehlin and Nichols, 1976; Vandenberg and Kelly, 1964); divorce (McGue and Lykken, 1992), amount of TV watched (Plomin et al., 1990), age at first sexual intercourse (Dunne et al., 1997), and combat exposure in Vietnam (Lyons et al., 1993).

In short, during the forty some years since Anastasi's original overview of the area, the empirical data have verified her conclusions. In fact, the growing knowledge of biology of the gene within neuroscience confirms her conclusions far more than any number of twin or adoption studies—the only types of data available to her at the time—could ever do. In terms of genes and environment, behavior is lemonade.

1.2 Lemonade: Implications

One may wax eloquently about the lemonade analogy, but the best way to illustrate lemonade is to take published media accounts—and sadly, some academic publications as well—and answer their rhetorical headlines in terms of the empirical evidence.

Is intelligence genetic? Stupid question—intelligence is lemonade. Do genes determine your personality? A completely idiotic thing to ask because personality is lemonade. Is alcoholism a genetic disease? Balderdash! Alcoholism is lemonade. Do males cheat on their spouses because of their genes? Bull. All

male behavior—as well as all female behavior—is lemonade. Is language genetic? Absurd! Language is lemonade because it needs environmental inputs and feedback to develop. In short, generic questions of the form "Is this genetic?" should never be asked in the first place for any types of behavior. Claims by any researchers that this or that behavior is "genetically determined" are false or, at best, pejorative to the English meaning of the word "determined."

At the opposite side of the spectrum, assertions by opponents to genetic research that geneticists propose some form of "genetic determinism" for behavior are equally ludicrous. Genetic determinism for any behavior implies that the correlation for identical twins on that behavior will be 1.0, but such a correlation has never been reported for any substantive human behavior. If there is any "genetic determinism" for a human behavior, it has yet to be reported. All human behaviors studied thus far are lemonade.

Perhaps more insidious are the tacit assumptions that individual differences in many human behaviors are environmental in origin simply because one or two environmental reasons explain some of those individual differences. The fact that environmental factors explain some of the individual differences cannot be used to conclude that environmental factors must explain all of the individual differences. Almost all—not 100% but pretty close to 100%–of human individual differences show some heritable influence.

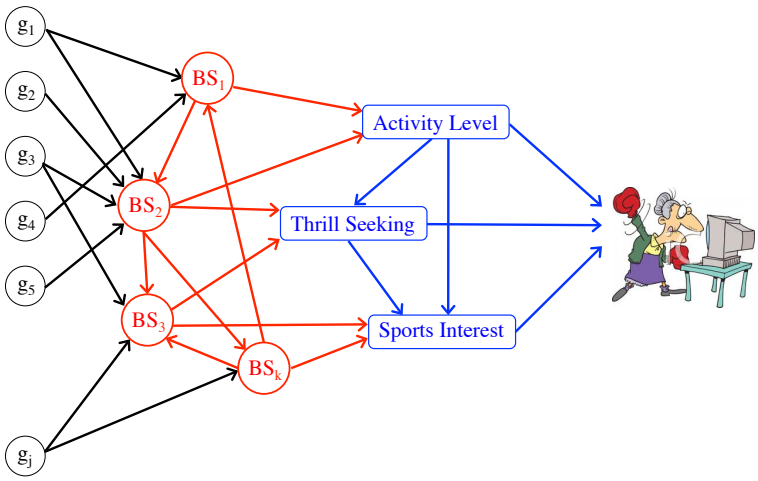
1.3 Lemonade: An example

If you are like many students of the social sciences, some of the previous statements will lead you to respond anywhere from "Huh?!" through "How can that be?" to "I don't believe that." Can there really be a genetic influence on the amount of TV watching or combat exposure in Vietnam? Let's take TV watching as an example.

Of course, the first thing we must consider about TV watching is the herring gull. Adult herring gulls have a bright red dot on the lower portion of their beak. Newly hatched chicks peck at this dot and the pecking stimulates that adult to regurgitate food for the chicks. In the lab, one can present hatchings with circles, squares, and other geometric shapes in varying colors. The young chicks will peck at a large array of objects, but they always peck considerably more often at a red circle. Early ethologists called this an "innate releasing mechanism" (Tinbergen, 1953). For whatever reason, the nervous system of the herring gull develops so that hatchlings are sensitive to red dots and respond by pecking. In adults, that same nervous system is sensitive to being pecked at and responds by regurgitation.

Back to TV. It is obvious that tens of millions of years of primate evolution followed by about five million years of hominid evolution and capped by 100,000 to 200,000 years of modern human evolution have not developed human neural circuits to make us "sensitive" to a television screen and respond by plopping on the couch. The genetic mechanism for TV watching is not the innate releasing mechanism that characterized much of the behavior of reptiles, insects, fish, and

Figure 1.1: Hypothetical model relating genes to TV watching.



some birds.

We are mammals and, as we will see later in Chapters X.X and X.X, our genes help in the development of a brain that adapts by learning and experience. Furthermore, our experience with other humans (our conspecifics) tells us that we learn to like different things. Hence, we are faced with the situation depicted in Figure 1.1.

The left-hand side depicts a series of genes, denoted as g_1, g_2, and so on. No genes directly influence behavior. Instead, they operate within cells that, that, in turn, influence different systems in the brain, the endocrine system (i.e., hormones), the immune system, and many other biological entities. Let's denote these generically as "biological systems" so that we can deliberately and perversely use the abbreviation BS. These are depicted by BS_1, BS_2, etc. in Figure 1.1.

Biological systems do not exist in vacuums. The activity and communication within one system often has effects on other systems. For example, the immune response to the flu influences behaviors like activity level and concentration. Hence, there are arrows among the biological systems.

The biological systems also influence a number of other behaviors relevant to TV watching. These are depicted in blue in the figure. In reality, there

are many more behaviors than can be practically depicted in the figure, but the three presented here should be sufficient to illustrate the general principle. These three variables are called *intervening variables* or *mediators*.

Our friends and acquaintances differ in activity levels. At one extreme, a few are "always on the go" while at the other end, some have trouble "getting up and going." Ask yourself: "all things being equal which of these two types is more to passively sit and watch TV?" Also, many forms of vigorous physical activity are completely antithetical with TV watching. How many downhill skiers can watch TV at the same time? Hence, individual differences in activity levels can be associated with TV watching. Genes that contribute to individual differences in the biological mechanisms that influence activity levels will also contribute to individual differences in TV viewing.

There is a well-established personality trait called thrill seeking. People high on this trait enjoy exhilarating but potentially dangerous activities such as skydiving and ice climbing. People very low on the trait find these activities terrifying and prefer more sedentary pursuits like gardening or reading. Once again, high thrill-seeking activities are incompatible with watching television. It is possible, however, to have the TV on as background entertainment during an intense bout of stamp collecting. Again, genes that influence biological mechanisms for thrill seeking can also impinge on the amount of television watched.

The final behavior is interest in sports. Like all human behaviors, genes partially influence interest patterns (Betsworth et al., 1994; Loehlin and Nichols, 1976; Vandenberg and Kelly, 1964). The effects of sport interests on TV watching, however, can be very heterogeneous. Personal engagement in most sports precludes TV watching, yet the interest itself promotes viewing of broadcasted professional and amateur competitions. Also, the influence of sport interests may change over the lifespan. Participation in physically demanding sports such as football and basketball wanes with age. Hence, the impact of genes on TV viewing that is mediated by sport interests does not have to be constant over development.

The generic principle is this: there are no genes that "directly" influence TV watching. Instead, genes, through their ubiquitous influence on biological systems have effects on a wide variety of behaviors. These behaviors, in turn, can increase or decrease the probability some people find TV watching rewarding while others find it boring.

We can now see how Anne Anastasi's "how" can be pursued through empirical research. Using current statistical tools with data on twins and adoptees we can actually test models such as the one in Figure 1.1. The phenotypes can be ones with more social relevance than TV viewing. Antisocial personality and alcohol abuse are two examples. And the intervening variables could include biological variables such as alcohol metabolism as well as psychological variables. This type of research is more likely to produce more fruitful results than studies of heritability alone.

1.4 Lemonade and this text

One hundred years of research suggests that human behavior is lemonade. It is an inextricable combination of genes, culture, family, and personal learning experiences—a compound, a solution. So what does one do now?

Anne Anastasi's suggestion is to focus research on the question of how genes and environment produce a phenotype. Indeed, much of the focus of this text will be placed on the how issue. Genes are biological entities. They are strands of DNA that are the blueprint for important chemicals in every cell of our bodies. To understand the how, we must first understand the gene and its biology. This is the topic of Chapters X.X through X.X. Known mechanisms of the "how" are portrayed in the chapter of Mendelian traits where the relationship between genes and behavior can be unequivocally viewed (Chapter X.X).

The transmission of genes also follows certain mathematical rules that were first outlined by Gregor Mendel in 1864 and later elaborated by Thomas Hunt Morgan and others shortly after the turn of the 20th century. These transmission rules permit scientists to calculate risk for genetic diseases in relatives as well as quantify the magnitude of the genetic influence on a trait from the correlations among different types of relatives.

Genes not only influence individual differences among us humans but they also help to define the very nature of our species. Genes decide that we humans have four appendages instead of six or eight, that we walk upright instead of on all fours, and that we have a very large cerebral cortex relative to our body size. These types of influences are evolutionary in nature and are discussed in chapters X.X through X.X.

Finally, a selected sample of the empirical literature on behavioral genetics of individual differences is reviewed in chapters X.X through X.X. The emphasis in these chapter is less on raising a flag toting "Genetic influence on intelligence discovered" than it is on tackling the major ways in which genes for intelligence relate to society today. Sadly, the "how" in these chapters is lacking, not because of any desire of this author or the efforts of researchers in the field. The lack of "how" studies derives simply from the nascent nature of the research into this question. One cannot explore the mysterious ocean about the "how" of genes and environment for personality, intelligence, schizophrenia, and antisocial behavior when such research is at the stage of placing one's toes into the water to test its temperature.

1.5 References

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