Why Do We Say Nature and Nurture Are Intertwined?
What Are the Building Blocks of Behavior?
What Is the Field of Behavioral Genetics?
How Does Evolution Occur?
How Does Evolution Influence Behavior?

Note about the image on this slide: Environmental factors such as stress, diet, smoking, and exercise, can influence whether a gene is turned on or off.

By “nature,” scholars mean contributions of our genetic inheritance to mind and behavior. This includes aspects of our evolved “human nature” as well as genetic differences among people.
By “nurture” scholars mean contributions of learning and environment to mind and behavior.
For many decades, even psychologists considered nature and nurture to be separate and opposing influences, and debated which was more important in explaining the human condition and individual differences between people.

Chapter three addresses the roles of nature and nurture as influences on the human mind.
The debate over the relative importance of “nature” versus “nurture” in explaining human behavior has gone on for many centuries, first among philosophers, and then among social scientists.

The perspective in psychology is now very different. Nature and nurture are both thought to play important roles in mind and behavior. Moreover, scientists have learned that genes respond in powerful ways to experience, and gene-based behaviors also shape the environment. Nature and nurture are deeply intertwined. In this woman, genetic traits combined with many years of training and experience produced a very talented ballerina.

When psychologists talk about “nature” as an influence on the human mind, they are referring to the effects of genetic inheritance. In healthy, normal people, every cell in the body carries the full set of DNA needed to provide the “blueprint” for a person.
Humans have 46 strands of DNA, or “chromosomes,” that spend most of the time in pairs as shown in this photo.
Individual “genes” are just sections of within these long strands.
An individual’s genotype is his or her actual set of DNA.

An individual’s phenotype consists of his or her observable characteristics. While the phenotype is influenced by the genotype, lots of environmental influences help determine how those genes are expressed.

This is because genes must be “expressed” in order to influence observable characteristics. Although every cell in your body contains your full genome, most of the genes in any given cell are at inactive most of the time.

In gene expression, one of the chromosomes unfolds stretching out one of more genes. The gene is used as a recipe for creating a protein. It is the protein, not the gene itself, that goes on to influence phenotype.

This is a model of the human hemoglobin protein, which allows red blood cells to pick up oxygen and transport it around the body. Without strong hemoglobin gene expression, this woman would not be able to keep up with the physical exertion required in dance.

Genes are not exactly the same from person to person. Even a gene like the hemoglobin gene varies a bit between people. Slightly different versions of the same gene are called “alleles.” Different gene alleles will lead to slightly different protein shapes, and in turn to different phenotypes.

For example, one allele of the hemoglobin molecule leads to a change in the shape of red blood cells, known as “sickle cells.” In this photo you can see a normal red blood cell on the left, and a sickled cell on the right.

Different alleles of the same gene may be useful in different situations. For example, having some sickled cells is helpful in tropical regions of the world, because they help protect against malaria. However, having only sickled cells is dangerous because they do not carry oxygen as effectively as normal blood cells, and are more likely to get stuck in blood vessels.

How can someone have “some” sickled cells, but not all? Normally an individual has not one, but two versions of each gene. One version is inherited from the mother and one from the father during sexual reproduction.

When the two alleles for some gene are the same, we say the individual is “homozygous” for that gene. When the two alleles are different we say the individual is “heterozygous” for that gene.

Sometimes one allele will clearly be dominant over the other. For example, the allele for proteins that lead to curly hair is dominant over the allele that leads to straight hair proteins, so even if this child’s father has perfectly straight hair, hers will be curly.

This is another example of the distinction between genotype and phenotype. Although the girl’s phenotype is “curly,” her genotype could include an allele for straight hair, and her own children could have straight hair as a result.

In sexual reproduction, the father and the mother each contribute a copy of one chromosome from each pair to the child. Which chromosome from each pair is chosen is determined at random, and may be different for each child.

The genotype of each child is created by something like a lottery, with alleles from the two parents being re-mixed across all of the 23 chromosome pairs.

This shuffling of alleles with every new offspring, combined with a slight chance of a mutation of mistake in the gene copying process, leads to considerable genetic variation among individuals in a population, and even among siblings in the same family.

LO3: Assess the importance of heritability estimates and epigenetic analyses in the field of behavioral genetics.

In biology, examples of genetic influence usually involve physical characteristics, such as hair type, eye color, and red blood cell shape.

Psychologists have also applied genetic principles to the understanding of human behavior in a field called “behavioral genetics.”
It can be fairly easy to document the influence of genes on variability in physical characteristics, such as hair and eye color, as long as one or a very small number of genes can explain that variability.

Explaining human behavior in terms of genes is much more difficult because behavior is so complex — no behavior can be explained in terms of different alleles of a single gene.

Before looking for gene alleles that might help explain variability in behavior, researchers must first find evidence that genes are involved at all. This usually means demonstrating heritability — the proportion of variability in some characteristic in the population that is likely due to genetic variability rather than differences in environment.

Heritability estimates are often made by comparing the extent of phenotype similarity in identical twins raised together versus those adopted and raised apart. For example, studies like these suggest that about 40% of the population variability in shyness can be explained in terms of genetic differences.

However, these studies are controversial because families must be screened rigorously before they are allowed to adopt; the resulting reduction in variability of the environment means such studies may underestimate the influence of environment.

Another complication is that genetic and environmental influences are not completely separate. Epigenetics is the study of the way genes and the environment interact to produce phenotypes. Features of the environment can influence which genes are expressed (translated into proteins) and when.

For example, stressful experiences early in life can change the expression of stress hormone genes for a lifetime. Fortunately, healthy experiences with loving caregivers can help offset these effects.

LO4: Analyze the roles played by mutation, natural selection, migration, and genetic drift as mechanisms of evolution.

LO5: Articulate the proposal that the human brain is an adaptation, and summarize the evidence supporting this proposal.

Genes influence the characteristics that make individual people different from each other, but they are also the mechanism that produces “human nature.” The process of evolution leads to species-typical characteristics, as well as distinctive characteristics held by large populations of people.

Researchers recently found evidence of remarkably recent evolution in humans. By comparing the hemoglobin genes of ethnic Tibetans with those of Han Chinese, Cynthia Beall and her colleagues (2010) found that the Tibetans had adapted to their environment within just the last 10,000 years or so.

How did this happen?

The first step in evolution is mutation. In order for parents to pass genes on to their children they must make copies of their genes. These copies end up in egg and sperm cells, which then combine to create a fertilized egg with a full set of human genes.

In the copying process, each chromosome unwinds and splits in half, as you see here. Each half is then matched up to the necessary molecules to make up the other half, using the existing half as a template.
Sometimes there is an error in the copying. Just like you might sometimes type the wrong letter or an extra letter in an essay, the copying process sometimes produces a slightly different copy than the original. This is called “mutation.”

At some point more than 10,000 years ago in China, someone was born with a mutation of the hemoglobin gene that led to reduced hemoglobin in red blood cells. Normally this would be a bad thing – hemoglobin binds oxygen, and we need oxygen to survive, so more usually is better.

Natural selection is often misunderstood – even by well-educated people – but it’s a very simple idea. Some mutations harm the individuals who have them, so those individuals have fewer offspring. As a result that mutation will probably die out of the population very quickly.

Other mutations, very rarely, will actually help the individual survive and reproduce. If the person who has such a mutation has more children than average, the mutation will be more common in the next generation. If this process continues for many generations, then the original, mutated allele can actually become typical of the species.

A mutation may not be inherently good or bad – it depends on the environment. In this case, the hemoglobin mutation we talked about is helpful if you are living at a very high altitude. The high regions of Tibet can be 10,000 feet above sea level or more. At this altitude oxygen in the air is very thin. People with normal red blood cells will then have many hemoglobin molecules that cannot bind oxygen, leading to altitude sickness.

Having less hemoglobin reduces vulnerability to altitude sickness. As a result, this hemoglobin mutation would have been beneficial for those living high in the mountains of Tibet. The mutation is far more common in ethnic Tibetans than in Han Chinese, whose ancestors lived at lower altitudes.

Finally, migration of small numbers of people, and genetic drift – chance factors that lead to changes in the concentration of alleles in some population – can also influence evolution.

In this case it is likely that people with the hemoglobin-reducing allele were more likely to move to higher altitudes in Tibet, leading to greater concentration of the allele in those population. The effects of migration and genetic drift can happen at the same time as the process of natural selection.

Scientists refer to a characteristic as an “adaptation” if it is held by most or all individuals in a species (or distinct population within a species, like ethnic Tibetans), if it is caused by genes, and if the high frequency of the gene or allele in question is due to natural selection.

Evidence suggests that the human brain is itself an adaptation. All people have brains with fairly similar structures and functions, and the development of the brain is clearly guided by genes. Mutations that affect development of the brain are often lethal.

Brains are certainly adaptive. Human cognitive abilities – especially those such as language, complex reasoning, and problem solving – are greater than those of any other species on earth. The human mind is arguably the most important resource for survival and reproduction our species has.
The size of the brain grew dramatically in early human ancestors or “hominins,” starting around 7 million years ago. Changes in brain size over time tracked changes in the sophistication of behaviors such as tool-making, hunting, social organization, and migration.

Although the average size of human brains has not changed for more than 100,000 years, brains have continued to evolve and people have gotten much, much smarter. It is likely that ongoing evolution of the brain has changed the way neurons connect to each other rather than the overall size of the brain.

Scientists often consider the behaviors of other animals to be adaptations. For example, newborn geese “imprint” on the first moving thing that they see. Although these baby geese imprinted on their actual parents, others have been found to imprint on humans. Imprinting is adaptive because it helps young, vulnerable geese stay close to their parents without having to be carried.

Evolutionary psychologists are also interested in the evolutionary origins of human social behavior. More than almost any other species, humans rely on each other for basic survival needs. Human social structure is extremely complex, and many aspects of human behavior are thought to be adaptations to our social world.

However, humans are not the only animals who will sacrifice themselves. Researcher Edward “E. O.” Wilson noted that bees and ants, who are closely related, will sacrifice themselves to save blood relatives.

Wilson proposed the notion of “inclusive fitness,” in which the individual’s genetic contribution is determined not only by his or her own offspring, but also the offspring of genetic relatives. Evidence suggests that humans are more likely to make life-threatening sacrifices for their close kin than for others, although kinship matters less for day-to-day cooperation.
Mating is another aspect of behavior that is strongly shaped by evolution. Building on evidence in non-human animals, some evolutionary psychologists have studied sexual selection – the impact of natural selection on traits that help an individual compete for mates.

Researchers distinguish between two processes. In intrasexual selection individuals of the same sex compete with each other for mates, and characteristics that help individuals win these competitions would be selected.

In intersexual selection, characteristics that attract potential mates – like the bright tail of the healthy male peacock – would be selected.

Humans engage in behaviors that seem to serve both purposes, such as displays of skill.

The field of epigenetics studies how individual people’s experience can alter their gene expression – one way in which nature and nurture can interact.

Researchers are also interested in the ways that culture and evolution can interact. It may seem obvious that human nature might help shape culture, but cultural practices can also help drive natural selection.

For example, both the Waorani (left) and the Yanomamo (right) societies are very warlike, fighting often with neighboring villages for scarce resources.

The Waorani tend to aggress against other villages at every encounter, not just during raids when resources are at stake. Perhaps as a result, the most aggressive men in the society tend to have fewer children than less aggressive men – a trend that could affect natural selection for any genetic factors influencing aggression.

In contrast, the Yanomamo (left) have a cultural norm of maintaining peace between tribes unless an actual raid is going on. In this situation aggression has greater payoff, and accordingly, men who are the most aggressive tend to reproduce the most.

The contrast between the two societies in terms of the correlation between aggressiveness and number of offspring highlights the role culture can play in shaping natural selection.