

## Introduction

Behavioral genetics, a concept that dates back to ancient times, but emerged as a distinct scientific discipline in the 1960s, examines the extent to which a particular gene or set of genes determines a person's behavior and in its more modern iteration, evaluates the gene-environment interaction (G x E) on a particular behavioral phenotype [1,2]. Based on this concept, some research has implicated specific genes in aggression and criminal behavior and, as such, a debate has arisen over whether criminals could use, as a defense, the assertion that they have a genetic predisposition for criminal behavior. More recent research has moved away from attributing direct causality to genes, but some research still does suggest that genes can, at least to some extent, impact behavior in that they can influence whether or not someone becomes aggressive as a result of an abusive environment. Yet, sources within Judaism teach that all people have free choice. Rambam, for instance, in very strong language writes:

Every man was endowed with a free will; if he desires to bend himself toward the good path and to be just, it is within the power of his hand to reach out for it, and if he desires to bend himself to a bad path and to be wicked it is within the power of his hand to reach out for it...Permit not your thought to dwell upon that which ridiculous fools of other peoples and a majority of asinine individuals among the children of Israel say, that the Holy One, blessed is He! decrees at the very embryonic state of every man whether he should be just or wicked. The matter is not so. Every man is capable of being as just as Moses our Master or as wicked as Jeroboam, wise or incony, merciful or human, miser or philanthropist, and so in all other tendencies [3].

How then would Jewish thought approach the idea of a genetic predilection, such as for crime? Although early Jewish sources do not mention genetics as we understand it now, sources that discuss parallels of genetic determinism, such as Rambam's use of the phrase "at the very embryonic state," can potentially shed light on our modern concept of genetic predisposition and give us a better understanding of how Jewish thought might view this idea.

## Genes and Behavior

As an example of a gene implicated in criminal tendencies, some studies have suggested that a gene variant that lowers monoamine oxidase A enzyme levels (MAOA-L), the so-called "warrior gene," could increase aggression and, therefore, could increase criminal behavior. The enzyme monoamine oxidase A (MAOA), localized on the outer mitochondrial membrane, breaks down the neurotransmitters serotonin, dopamine, norepinephrine, epinephrine, melatonin, tyramine, and tryptamine, [4] called monoamines because they have one amine (NH<sub>2</sub>) functional group [5]. Low levels of this enzyme cause elevated levels of the target neurotransmitters to accumulate in the synapses, while extra high levels of the enzyme would decrease target neurotransmitter levels. Altered neurotransmitter levels in turn could impact brain function, which could potentially influence behavior [6,7]. The gene variant type at work here [8] is a variable number of tandem repeats (VNTR), meaning that a short nucleotide sequence repeats a number of times in tandem within a gene and the number of repeats can vary among individuals [9]. The *MAOA* gene has variants of two, three, three and a half, four, and five repeats of a thirty nucleotide sequence; the two and three repeat variants (MAOA-L) cause monoamine oxidase A production to decrease [6]. The fact that the *MAOA* gene resides on the X chromosome (short arm), such that males only have one copy, might render males more susceptible to its inactivity [4,6]. For women, in contrast, a study showed that *high* monoamine oxidase A expression (MAOA-H), with VNTRs of 3.5 or 4, in combination with childhood trauma or adverse environment, might lead to aggression, though the study did have limitations [10].

The history of a perceived association between MAOA-L and aggression traces back to a 1993 study by Brunner of a family in which the males had functionally no MAOA enzyme due to a C to T point mutation that created an early stop codon [11] and in which these males displayed "impulsive aggression" [12]. In 1997, Sabol *et al.* found that the number of VNTRs impacted levels of MAOA expression and mentioned possible implications for behavior [13]. In 2004, a study that compared the gene in monkeys to that in humans used the label

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“warrior” [14]. In 2006, the media in New Zealand reported on a study that found an increased presence of the MAOA-L variant in the Maori people as compared to the general population and, as previously discovered, this variant had been associated with aggression. The study was taken to attribute genetic aggressiveness to the Maori people [15]. Researchers and commentators quickly took this attribution to task and the study generated a lot of backlash, with the main objection that a single gene alone does not contribute to something as complex as behavior [16,17,18]. According to Hunter, forty percent of the general population has the MAOA-L variant and yet, not all forty percent exhibit criminal behavior: “the MAOA-L variant is extremely common and occurs in about 40% of the population. Clearly, most of these people are peaceable and have never committed a crime...” [19]. Moreover, an earlier 2002 study by Caspi had shown that the link to aggression occurred only when genetically susceptible individuals experienced childhood abuse [20]. Though the Caspi study and other similar research modifies the underlying deterministic factor from just genes to genes plus environment, the research does still raise the question of free choice: considering that a gene variant can influence a person’s response to an abusive environment, if a person with the gene variant does experience that environment, would he or she then have free choice?

Additionally, some studies also have suggested a link between the XYY karyotype and problematic behavior, as these findings have shown increased risk for behavioral difficulties and “increased risk of impulsivity,” though the link between XYY and criminality “must be viewed with extreme caution, given their reliance on small sample sizes and selected rather than broader-based sampling approaches” [21,22]. Similarly, genetic polymorphisms in the genes that code for the serotonin and dopamine transporters have been linked to behavioral disorders, once again taking the role of environmental factors into account [23,24]. Though the research of the 1970s sought to find a direct connection between these genes and criminal behavior, the more current research remains more cautious about definitively linking genes to behavior without including environmental influences. However, current research does leave open the possibility that genetic polymorphisms could play a role in certain traits such as impulsivity, which, without intervention, could become a risk factor for behavioral problems and again raises the question of free choice

in a situation in which the person did not grow up in an environment that provided intervention.

### Rabbinic Sources on Determinism

Chazal in the *gemara* address the idea that someone could be born with murderous tendencies. Chazal do not discuss genetics, but they do discuss whether the constellations predetermine this trait and other aspects of a person’s life. *Gemara* Shabbat (156a) delineates the outcome for someone based on the day of the week and planetary influence of their birth. The *gemara* explains, according to astrology, each zodiac sign falls under either a ruling planet, the sun, or the moon. One born under the influence of the planet Mars, possibly because of its red color, will become “one who spills blood.” Rav Ashi responds that they can become a blood-letter, a thief (according to Rashi, this refers to a thief who kills), a *shochet*, or a *mobel*. Rabba questions the concept of astrological determinism by saying that he in fact born under the influence of Mars and does not do any of these activities. Abaye responds with: you punish and kill. (Rashi explains this statement to refer to people who go against his word, presumably people who get the death sentence for going against his rulings). Rav Ashi’s comment seems to suggest that if one is born with an inclination for blood, one can channel this natural predetermined birth trait into a profession that involves blood, in fact, even into a profession that helps people. One born to “spill blood” does not have to do so via murder but could do so in these other ways.

Along similar lines, on the issue of inborn traits, Chazal also discuss how everything which is prohibited has a permitted equivalent. In Chullin (109b), Yalta states this idea and lists several examples, including a fish called *shibuta*, whose brains taste like pork. This *gemara* suggests that even in a situation of inclination for something non-permissible, other options exist to prevent someone with a negative inclination from doing the wrong thing. Even if someone were to have the predetermined inclination to eat pork, they instead could eat the *shibuta* fish.

In Moed Katan (28a), Rava states that three things are determined by *mazal* rather than by merit: length of life, children, and sustenance [25]. Perhaps of note, the first two of these three items potentially have a genetic component. Tosafot on this *gemara* inquire that the subsequent statement in Shabbat (156a) that “there is no *mazal* for the Jewish people” seemingly contradicts this *gemara* in Moed Katan. Tosafot, in their comments on Shabbat (156a), note that sometimes, with great

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merit, *mazal* can change whereas, sometimes, it does not. The *gemara* in Moed Katan resolves the contradiction by saying that while sometimes *mazal* changes, like in these cases, at times it may not [26]. The Tosafists seem to take the view that sometimes something predetermined changes while sometimes it does not, at times depending on great merit. Whereas for the *gemara* and for Tosafot, determinism takes the form of “*mazal*”, fate, our later understanding of genetics might also inform our reading of their discussion on this topic, as *mazal* could include genotype.

Rabbi Dessler in his book *Michtav me-Eliyahu* discusses the question of environmental influences counteracting free will—the same question of environmental determinism raised by Caspi’s research—and writes, “...no one is held responsible for the evil to which he is accustomed from birth and as a result of his environment...he has the *halachic* status of ‘a child taken captive and brought up among idolaters’” [27]. Rabbi Dessler also establishes the idea of a *bechira*, choice, a point at which everyone has free choice, though potentially in different circumstances for different people. For someone raised in a righteous environment, his/her *bechira* point might be to observe a commandment more scrupulously, whereas for someone born to thieves, the *bechira* point might be to behave honorably while they steal [28]. This idea asserts that people have free choice within the confines of their surrounding environment.

### Legal Context

When Appelbaum *et al.* surveyed cases in WestLaw and LexisNexis (now called NexisUni) as well as in Ovid MEDLINE, PsychINFO and Embase from 1995 to 2016, they found that so far, only in eleven cases, nine in the United States and two in Italy, did MAOA-L genetic evidence get admitted as evidence for the defense [29]. Of the eleven cases, only in one case did it change the guilt phase of the case and only in two cases did it change the sentencing or appeal phase, when the defendants had both the genotype and an abusive upbringing [29]. The authors opine that “[e]ven when charges or sentences are reduced, it is difficult to gauge the effect of evidence of the MAOA-L genotype. Genotype evidence may lack persuasive effect because the impact of the allele on a particular accused is difficult to establish” [29]. The authors point to their limited access to court documents and the fact that they only looked at English-language

cases as limitations to the study.

### Conclusion

The topic of genetic determinism has never been clear-cut. Though genes exert their influence, environment also plays a significant role in their outcome. The scientific literature reflects this ambiguity in that no one study conclusively shows that genes alone can alter behavior, although simultaneously, some research does suggest the idea of a genetic disposition. Studies also have shown that temperament, which emerges in early childhood and shows distinctiveness between different children, has a “strong genetic component”, while at the same time, “the family environment moderates the heritability of temperament” [30,31]. Similarly, Jewish sources point to the idea of temperament and the need to shape the environment in accordance with the phrase “train a lad *in the way he should go*; he will not swerve from it even in old age” in Sefer Mishlei (22:6).

In discussing ways by which one can improve one’s character, Rambam writes:

Pertaining to tendencies in general, there are such tendencies that a man acquires at his birth, in keeping with the nature of his body; and there are particular tendencies to which a particular person is by nature prepared to acquire them more aptly than other tendencies; there are among them such which do not come naturally to a person at his birth, but which he learns from others, or by leaning towards them as a result of a thought invented by his heart, or by having heard that this particular tendency is good for him and proper to follow it, and he did follow it until it was set in his heart [32].

Perhaps the “tendencies that a man acquires at his birth” seem reminiscent of genetic traits and “in keeping with the nature of his body”, their corresponding physical genes as known to us today, while “which he learns from others” speak to environmental influences. This statement does not contradict Rambam’s view on free will, as he explains that one can cultivate a trait at the opposite extreme of an undesirable trait, which would pull one’s natural tendency toward the middle and thereby enable one to achieve the golden mean [33].

In 1962, Marian Diamond *et al.* published their groundbreaking research on brain plasticity and in doing so, turned around the firmly established notion that the brain remains static and genetically

predetermined [34,35]. Their research showed that the cerebral cortex size increased in rats who lived in an enriched environment, in contrast to those of rats raised in an impoverished environment, an experiment that showed for the first time that environment can actually alter the physical anatomy of the brain [35]. Their research has many implications for activities or conditions that impact the brain. Positive influences include reading aloud to children, running, meditation, bilingualism, playing a musical instrument, and staying socially connected [34]. Negative influences include childhood poverty, fear, trauma, isolation, sleep deprivation, low socioeconomic status, and protein deficiency [34]. Perhaps one can liken the gene to environment interaction to a pinball machine, where if one flips one or the other of the two flippers, the ball might propel slightly, but if one flips both in unison, it

creates a much higher chance that the ball will propel with force. As scientific research progresses in the area of behavioral genetics, it likely will continue to discover new insights into genetic and environmental influences on behavior. Analyzing these findings along Jewish sources can allow us to gain an added perspective on how Judaism might view this new information.

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- [25] In support of Rava's statement, the gemara describes two Rabbis, Rabba (the same who questions Rav Ashi's statement) and Rabbi Chisda, who were so equally righteous that when each prayed for rain, it rained, yet Rabbi Chisda lived an amazing and long life--sixty wedding feasts in his family and until age 92--whereas Rabba lived in poverty and died young--sixty calamities and at age 40.
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