Talent Development as a Multidimensional, Multiplicative, and Dynamic Process

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Abstract

Recent empirical research has challenged the common belief in the existence of talent, suggesting that exceptional performance is entirely the product of nurture rather than nature. However, this research has been based on a simple conception of what talent entails. Rather than involving a unidimensional, additive, and static genetic process, talent may instead emerge from a multidimensional, multiplicative, and dynamic process. This latter possibility is described in a two-part model that combines multidimensional and multiplicative inheritance with dynamic development. The first part of the model handles domain specificity, profile heterogeneity, the distribution of individual differences, familial heritability, and domain complexity. The second part explicates early- versus late-bloomers, early signs of talent, talent loss, and shifts in the domain of talent. The resulting model has crucial implications for how best to gauge the impact of nature in the development of talent.

Keywords

talent; genetics; emergenesis; epigenesis

Talent has a somewhat strange status within psychology. On the one hand, the concept is commonplace in everyday psychology. Teachers often speak about some of their students having more talent than others, and coaches freely use the term to describe the differential performance of their athletes. Moreover, conversations among diverse people, including psychologists, will often contain statements like "I have no talent for mathematics" or "You have a genuine talent for business." Talent is frequently counted among the personal capacities responsible for the exceptional performance of a violin virtuoso, Olympic champion, or "math wiz."

On the other hand, recent psychological research has increasingly cast doubt on the very existence of talent (Howe, Davidson, & Sloboda, 1998). Instead of being blessed with innate gifts, the individuals who demonstrate world-class performance in any skill domain are simply those who have engaged in a great deal of deliberate practice (Ericsson, 1996). In this egalitarian view, all people can become stars in almost any domain if they only apply themselves arduously to the task of mastering the requisite knowledge and skills. There is no need whatsoever to make attributions about innate abilities in music, sports, or any other domain of achievement.

Although this second, environmentalist position may seem extreme, it seems to enjoy considerable empirical support. There certainly can be no doubt that environmental factors play a major role in the development of talent. There also can be no question that developing talent necessitates a laborious and lengthy process of acquiring expertise. Typically, a full decade of extensive work and study is required to attain exceptional levels of performance in any skill domain. At the same time, attempts to isolate a genetic basis for many talents have often failed miserably. There appears to be no identifiable "gene" for music or mathematics or sports. In addition, investigations have cast doubts on whether talented children display their gifts early enough for us to be sure that their skill was the manifest result of nature rather than nurture (Howe et al., 1998).

However, before psychologists conclude that the concept of talent should be relegated to the collection of myths and superstitions that fill folk psychology, it should first be given a systematic and sophisticated scientific appraisal. After all, it could be the case that most researchers have viewed talent in an overly simplistic fashion. If so, then psychologists may have rejected the concept simply because they have been looking for it in the wrong place. Let me now sketch what I consider a far more complex and realistic conception of this phenomenon. It consists of two parts, the emergenic and the epigenetic.

EMERGENIC INHERITANCE

The model begins by assuming that most talent domains are not contingent on the inheritance of a single trait. On the contrary, most are assumed to be complex enough to require the simultaneous inheritance of several traits. In other words, endowed capacity usually consists of multiple components. These components include all physical, physiological, cognitive, and dispositional traits that facilitate the manifestation of superior expertise in a talent domain. Some of these component traits may concern mostly the acquisition of the necessary expertise, whereas other components may largely affect the performance of whatever expertise has already been acquired. To simplify discussion, let us suppose that each of these genetic traits varies along a ratio scale, that is, along a scale that consists of positive numbers and begins at zero, which represents the total absence of the corresponding characteristic from the individual's genes. This would reflect the situation in which each component of talent depends on numerous genes that may be inherited in any combination (i.e., the trait is polygenic, with the possibility that none of the genes are inherited).

For most talent domains, these multiple components are presumed to operate in a multiplicative, rather than additive, manner. That is, the hypothetical scores of the component traits are multiplied, rather than added together. This means that if any of the essential components is absent, then the corresponding talent is absent, too. In other words, if a trait is truly required for the acquisition or performance of a particular talent, then its absence exerts veto power over the manifestation of that talent. Another way of stating this is that many talents may demand a specific combination of traits, all of which must be present in order for the talent to exist at all. Moreover, a particular weighting of components is needed to optimize talent in a given domain; that is, the various components have differing importance to the domain (and different domains that require the same components may depend on them to different degrees). This configurational type of genetic inheritance has been called *emergenic* by Lykken (1982, 1998) and his colleagues (Lykken, McGue, Tellegen, & Bouchard, 1992).

Talents inherited according to this multidimensional and multiplicative process would operate in a fashion rather more complicated than is commonly assumed. The following four consequences are worth special attention:

1. Domain Specificity May Reside in Configurations of Components

Although it is often assumed that talents are domain-specific (e.g., math talent, music talent, sports talent), it is not necessary to assume that all of the genetic components that contribute to a given talent are themselves domain-specific. Although some of these components might be somewhat domain-specific (e.g., height for basketball players), some undetermined number may instead be rather generic (e.g., general intelligence, or what some psychologists refer to as g). As a consequence, the domain specificity of many talent domains may actually reside in the configuration of essential traits, not in the traits themselves. The genes that provide the basis for one talent may actually contribute to the emergence of other talents besides, but in different combinations. Moreover, there might even exist two talents that require the same components, but assign those components different weights (e.g., kindred talents like music performance vs. music composition). There already exists ample evidence that inheritable traits can contribute to more than one talent domain, but with distinctive emphases according to the specific demands of each domain (Simonton, 1999). An obvious example is the role that height plays in various sports; although it contributes to talent in many sports, it contributes to varying degrees.

2. Different Profiles May Yield the Same Talent

Two individuals in the same talent domain do not have to inherit the same traits to the same degree in order to display the same level of genetic endowment for that talent. It is the total product of the components that determines the degree of talent. So long as no component is zero, the two individuals can possess extremely heterogeneous profiles and still exhibit the same overall level of talent. For example, two painters could have the same overall talent, but one inherits superior color discrimination whereas the other inherits superior sensitivity to form. Hence, there is not necessarily a single genetic endowment underlying a given talent domain. By the same token, two individuals may both lack talent for a particular domain, but exhibit extremely heterogeneous genetic profiles, because it takes only one missing component to veto the manifestation of the corresponding talent, and the missing component need not be identical for the two persons. Neither the talented nor the untalented form genetically homogeneous groups.

3. Distribution of Talent in the Population Does Not Necessarily Show a Bell-Shaped Curve

It is often assumed that most human characteristics are normally distributed in the general population. Presumably, the genetic components underlying a given talent domain would also be described by the same bell-shaped curve. The sum of these components would also be normally distributed. Yet under the nonadditive emergenic model, the product of these components would not fit a normal distribution. Instead, any multidimensional and multiplicative talent would exhibit an extremely skewed (loglinear) distribution. At one extreme, a large proportion of the population would have no talent whatsoever, because they lack one or more essential components. At the other extreme would be those few individuals who are several standard deviations above the mean. Exceptional talent would be extremely rare in any complex domain. A considerable amount of empirical data shows that the distribution of performance in the general population is most accurately described by curves that are highly skewed right rather than symmetric (Walberg, Strykowski, Rovai, & Hung, 1984). For example, creative productivity is characterized by such a distinctive distribution (Simonton, 1997).

4. Talent Shows Low Heritability

Talent, according to the proposed model, is much more difficult to predict than would be the case were talent defined as a simple homogeneous construct. Most researchers attempt to predict performance in talent domains according to the usual linear and additive models. To the extent that a talent is actually multidimensional and multiplicative, the predictive power will be attenuated—even when all the components have been reliably assessed. More remarkably, such talents cannot even be predicted according to family pedigrees. Emergenic talents necessarily exhibit low familial heritabilities. A child cannot inherit a talent from his or her parents unless the whole configuration of component traits is inherited, and the odds of that happening are extremely small. In fact, only identical (monozygotic) twins would receive equivalent talents. This feature provides a useful technique for determining whether a given talent is emergenic. A talent that exhibits zero heritability for fraternal twins but high heritability for identical twins would best fit the emergenic model. Empirical evidence for such emergenesis has already been found for creativity, leadership, and other talents (Lykken et al., 1992; Waller, Bouchard, Lykken, Tellegen, & Blacker, 1993).

Discussion

The foregoing implications depend on the assumption that a talent domain is multidimensional. Yet it is probably the case that domains differ greatly in their complexity; that is, they may vary in the number of essential components. Some talents may demand only one or two genetic components, whereas others may require a dozen or so. Playing chess may require far fewer genetic traits than composing operas, for instance. The consequences I have just described become intensified to the extent that a talent domain is multidimensional. The more complex talent domains should exhibit more heterogeneous trait profiles, more extremely skewed distributions in the general population, and reduced familial inheritance.

EPIGENETIC GROWTH

Although talent is seen as a complex behavioral phenomenon under the emergenic model, the model needs to incorporate another critical complication: Genetic traits do not manifest themselves all at once at birth, but rather, they must develop according to inherited epigenetic trajectories (i.e., innate developmental pathways). It is for this reason that identical twins reared apart will tend to become increasingly similar with age (rather than more dissimilar, as one would expect if the environment exerted increasing influence with maturation). Accordingly, each of the components making up a particular emergenic talent should possess its own distinctive growth pattern. This epigenetic pattern will determine when the trait's development begins to "kick in," the speed at which it grows, and the point at which growth levels off and terminates. Talent development must be a dynamic process such that the very composition of a youth's talents transforms over the course of childhood, adolescence, and early adulthood. Such an epigenetic-emergenic model has the following four repercussions:

1. There May Not Be Early Indicators of Talent

Although many researchers have looked for early indicators of specific talents (e.g., perfect pitch for music talent), such indicators are not required for talents that are emergenic and epigenetic. The first component to begin growth for one individual might be among the last to develop for another individual. In fact, at least in theory, there are as many ways to initiate talent development as there are components contributing to acquisition and performance.

2. Different Individuals May Begin to Exhibit the Same Talent at Different Ages

The model provides a genetic basis for understanding the distinction between early- versus late-bloomers. Under an additive model, a talent begins development when the first genetic component first emerges, whereas under a multiplicative model, the talent does not begin to grow until the last component begins development. A late-bloomer, in contrast to an early-bloomer, is a youth who has at least one talent component with a retarded growth curve. Because the component does not initiate growth until later than normal, the composite talent must wait longer to materialize.

3. An Individual's Apparent Talents Change Over Time

If the innate capacity for exceptional performance in a particular domain is multidimensional, and if each component has its own distinctive growth trajectory, then a youth's optimal talent domain will not be stable over time, but rather will change. As new components initiate their development, the youth may discover a greater proclivity for some related domain of achievement. For instance, a child might start out playing piano, transfer to composition, and end up becoming a conductor.

4. Talent Can Be Lost

Because talent is not stable over time, it is possible for certain individuals to suffer a loss in talent as they grow older. The promising child may become a mediocre adolescent. According to the epigenetic model, there are two types of talent loss, relative and absolute. In relative talent loss, an individual's magnitude of talent decreases in comparison with the magnitude of talent of others in the same cohort. This can occur because other individuals have epigenetic trajectories with later onsets but more rapid growth rates. Hence, a late-bloomer might overtake an early-bloomer. In absolute talent loss, certain genetic traits that are detrimental to the further growth of the overall talent (e.g., increased weight for gymnasts) begin to develop. Ultimately, the talent may vanish altogether.

Discussion

Taken together, these implications suggest that talent can develop in very different ways for genetically distinct individuals. Two adults with the same talent may have developed that talent via contrary epigenetic routes, and two adults with totally different talents may have had very similar childhood talents. Moreover, even individuals who more or less stay in the same talent domain throughout their youth may display contrasting spurt and lull periods, so that their relative level of talent may constantly change over time. The possibility that talent domains vary greatly in the number of essential components makes matters all the more intricate. The more components that participate in the constitution of a given talent, the greater the heterogeneity of available epigenetic profiles for that talent. In addition, in comparison with simple domains, highly complex domains are likely to require much more time before all the requisite components initiate and complete their growth trajectories. Hence, talent for simple domains might appear in childhood or early adolescence, but talent for complex domains may not emerge until late adolescence or early adulthood.

CONCLUSION

Although I have presented this model of talent development in conceptual terms, the same model has already been translated into a more mathematical form (Simonton, 1999). Moreover, this more formal version of the emergenic and epigenetic model can accommodate several complications so far ignored in the present discussion. For instance, the model has been extended to cover traits that operate in a dichotomous fashion or that cannot be reduced to implicit ratio scales. In addition, the model has been expanded to permit the possibility that some genetic traits may contribute to a particular talent in an additive rather than multiplicative manner. In fact, the simple-versus-complex and additive-versus-multiplicative dimensions define four types of talent (Simonton, 1999). Where a talent domain fits in this typology can be inferred from its distribution in the population and its typical developmental pattern.

Given this more complex conception of talent, it becomes clear that psychologists must scientifically address the following empirical questions: What are the essential components of various talent domains? Which of these necessary components are substantially heritable? Which components are cognitive and which dispositional? Which affect acquisition of expertise, and which affect performance? Which domains display highly skewed distributions even after individual differences in deliberate practice are taken into account? According to modern behavior genetic methods, which talent domains exhibit a pattern of inheritance clearly more emergenic than familial? What are the typical epigenetic trajectories of the various talent components? To what extent are these trajectories under genetic control? And finally, how do environmental factors—including deliberate practice—interact with these epigenetic trajectories in the final realization of talent? Once these questions are addressed, psychologists will obtain a more sophisticated understanding of how nature and nurture jointly determine talent development.

Recommended Reading

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Note

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If the Television Program Bleeds, Memory for the Advertisement Recedes

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Abstract

In public surveys, the most common complaint about television is the amount of violence depicted on the screen. More than half the programs shown on television are violent, and hundreds of studies have shown that viewing TV violence causes an increase in societal violence. Nevertheless, advertisers continue to sponsor violent programs. For an advertisement to be effective, people should be able to remember the brand advertised and the message in the advertisement. This article reviews the effect of TV violence on memory for ads. A meta-analysis integrating the results from 12 studies involving more than 1,700 participants shows that TV violence impairs memory for ads. The impairment occurs for males and females, for children and adults, and for people who like and do not like to watch TV violence. These results suggest that sponsoring violent programs might not be a profitable venture for advertisers.

Keywords

televised violence; memory; commercials; meta-analysis

Since it was introduced at the 1939 World's Fair in New York, television has become an integral part of American society. The average number of American households with TV sets has increased from 9% in 1950 to over 98% in 1998. The ratio of television sets to people is higher in the United States than in any other country, about 776 per 1,000 people. There are more television sets in the United States today than there are toilets.

EXTENT OF VIOLENCE ON TELEVISION

Surveys indicate that most Americans believe there is too much violence on television. In one survey, for example, people were asked to say, in their own words, what made them angry about television programming. The most common complaint was "too much violence" (TV Guide, 1992). In the National Television Violence Study (1998), researchers videotaped more than 8,000 hr of programming on cable and broadcast television in the United States, sampling between the hours of 6:00 a.m. and 11:00 p.m., 7 days a week, for 3 consecutive years. A content analysis showed that about 60% of the programs contained violence. Less than 4% of the violent programs contained an antiviolence theme. In most programs, violence was depicted as trivial, glamorous, and sanitized.

Over time, the number of violent acts an individual sees on television can accumulate to a staggering amount. By the time the average American child graduates from elementary school, he or she will have seen more than 8,000 murders and more than 100,000 other assorted acts of violence (e.g., assaults, rapes) on network television (Huston et al., 1992). The numbers are even higher if the child has access to cable television or a videocassette player, as most children do.

EFFECT OF TELEVISED VIOLENCE ON SOCIETAL VIOLENCE

Scholars have been investigating television violence as a potential