

The Genetics of Talent Development

**Putting the Gift Back into
Giftedness**

Introduction:

The Nature-Nurture Controversy

- **Nature:**
 - Galton's (1869) *Hereditary Genius*
 - Galton's (1874) *English Men of Science*
- **Nurture:**
 - Behaviorist Learning (e.g., Watson)
 - Expertise Acquisition (e.g., Ericsson)
 - Deliberate Practice
 - The 10-year Rule

Integration: Behavioral Genetics

- **Environmental Effects**
 - Shared (e.g., parental child-rearing practices)
 - Nonshared (e.g., birth order)
- **Genetic Effects**
 - Additive versus Nonadditive (emergenic)
 - Static versus Dynamic (epigenetic)
- **Genetic \diamond Environmental Effects**
 - e.g., “deliberate practice”

Definition: Potential Talent

- Any genetic trait or set of traits that
- accelerates expertise acquisition and/or
- enhances expert performance
- in a talent domain (e.g., creativity)
- Traits may be
 - cognitive (e.g. IQ) or dispositional (e.g., introversion),
 - specific (e.g., perfect pitch) or general (e.g., *g*)

Two-Part Genetic Model

- Emergent Individual Differences
- Epigenetic Development

Emergenic Individual Differences: The Model

$$P_i = \prod_{j=1}^k C_{ij} w_j$$

Emergenic Individual Differences: The Model

- P_i is the potential talent for the i th individual
- C_{ij} is the i th individual's score on component trait j ($i = 1, 2, 3, \dots, N$)
- w_j is the weight given to the j th component trait ($w_j > 0$)
- $_$ is the multiplication operator (cf. $_$)

Emergenic Individual Differences: The Model

$$P_i = \prod_{j=1}^k C_{ij} w_j$$

Emergent Individual Differences: The Implications

- **the domain specificity of talent**
- **the heterogeneity of component profiles within a talent domain**

*Hypothetical Profiles for
Children with Equal High Talent
($n = 5, k = 3$)*

Child (i)	C_{i1}	C_{i2}	C_{i3}	P_i
1	5	5	4	100
2	50	2	1	100
3	2	2	25	100
4	1	20	5	100
5	100	1	1	100

*Hypothetical Profiles for
Children with Zero Talent ($n = 5,$
 $k = 3$)*

Child (i)	C_{i1}	C_{i2}	C_{i3}	P_i
1	0	0	0	0
2	5	0	50	0
3	20	20	0	0
4	100	0	0	0
5	0	5	5	0

Emergent Individual Differences: The Implications

- **the domain specificity of talent**
- **the heterogeneity of component profiles within a talent domain**
- **the skewed frequency distribution of talent magnitude**
- **the attenuated predictability of talent**
- **the low familial inheritability of talent**
- **the variable complexity of talent domains**

Emergenic Individual Differences: Monte Carlo Simulation

- **Component scores based on 5-point (0-4) scale, randomly generated under a binomial distribution ($p = .5$)**
- **$N = 10,000$**
- **Trait components' weights set equal to unity for both models (i.e., $w_j = 1$ for all j)**

<i>Univariate</i>	+	+	+	X	X	X
<i>Statistics</i>	$k = 1$	$k = 5$	$k = 10$	$k = 1$	$k = 5$	$k = 10$
<i>M/k</i>	2.01	2.00	2.00	2.01	6.43	106.93
<i>SD/k</i>	1.00	0.45	0.32	1.00	9.06	320.06
Skewness	0.02	-0.02	0.02	0.02	3.04	10.69
Kurtosis	-0.50	-0.13	-0.07	-0.50	14.41	207.32
% $P_i = 0$	5.84	0.00	0.00	5.84	26.79	46.94
Max z Score	1.99	3.56	3.76	1.99	10.60	32.47

<i>Regression</i>	+	+	+	X	X	X
<i>Statistics</i>	<i>k = 1</i>	<i>k = 5</i>	<i>k = 10</i>	<i>k = 1</i>	<i>k = 5</i>	<i>k = 10</i>
Mean β	1.00	0.44	0.31	1.00	0.35	0.17
Equation R^2	1.00	1.00	1.00	1.00	0.61	0.29
Maximum t Residual	0.00	0.00	0.00	0.00	12.67	38.75

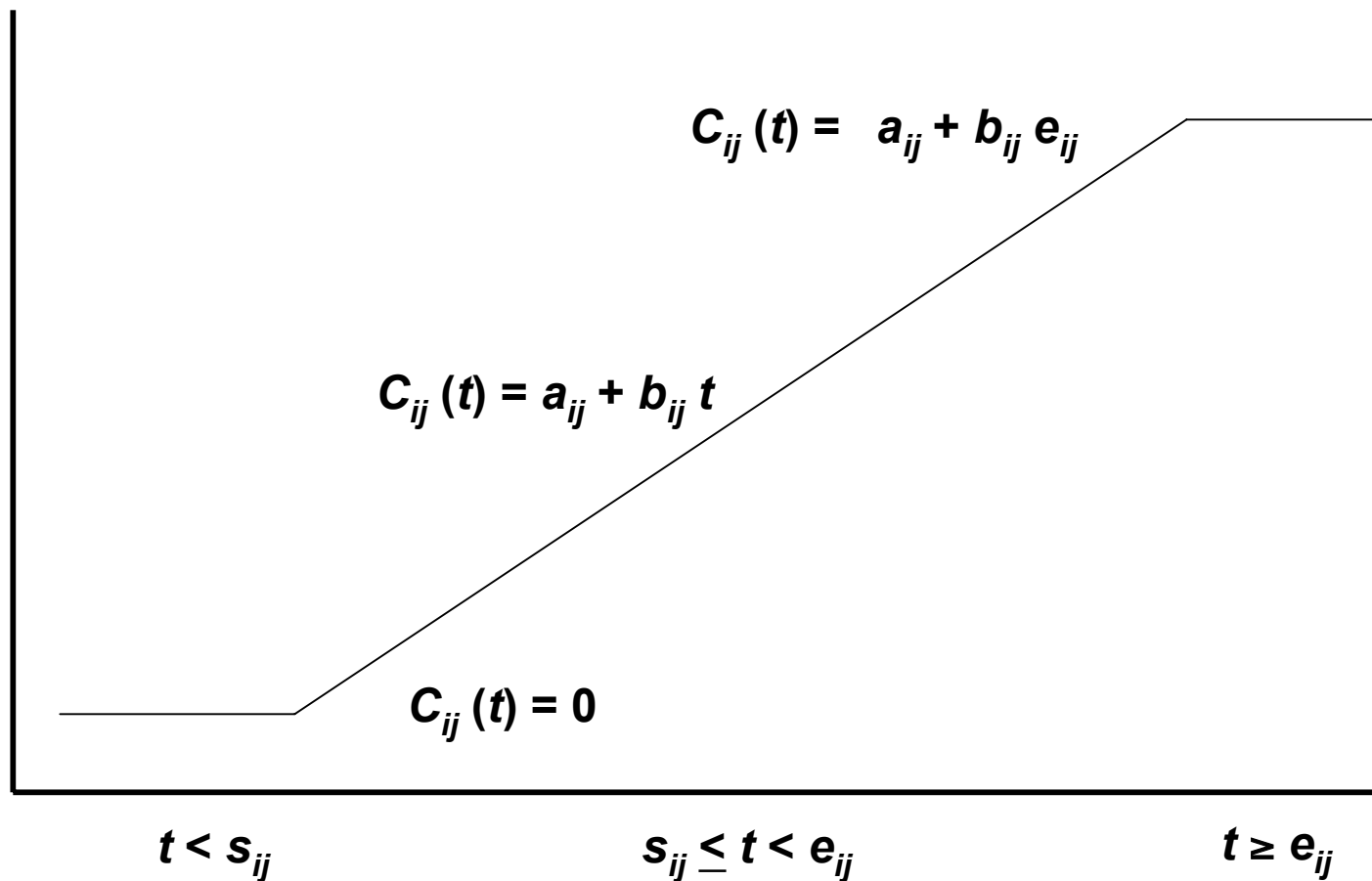
Epigenetic Development: The Model

$$P_i(t) = \prod_{j=1}^k C_{ij}(t)^{w_j}$$

e.g.

$$\begin{aligned} C_{ij}(t) &= 0, \text{ if } t < s_{ij}, \\ &= a_{ij} + b_{ij} t, \text{ if } s_{ij} \leq t < e_{ij}, \text{ and} \\ &= a_{ij} + b_{ij} e_{ij}, \text{ if } t \geq e_{ij}. \end{aligned}$$

Epigenetic Development: The Model



Epigenetic Development: The Implications

- **the occurrence of early- and late-bloomers**
- **the potential absence of early talent indicators**
- **the age-dependent cross-sectional distribution of talent**
- **the possibility of talent loss (absolute vs. relative)**
- **the possible age-dependence of a youth's optimal talent domain**
- **the increased obstacles to the prediction of talent**

Conceptual Elaboration

- **the ratio scaling of the talent component traits (cf. thresholds)**
- **the postulate of uncorrelated components, and**
- **the integration of the k component traits using a multiplicative rather than an additive function**

Conceptual Integration

- **Fourfold Typology of Genetic Gifts**
- **Additive versus Multiplicative Models**
- **Simple versus Complex Domains**

Fourfold Typology of Genetic Gifts

	Additive	Additive	Multiplicative	Multiplicative
Results	<i>Simple</i>	<i>Complex</i>	<i>Simple</i>	<i>Complex</i>
<i>Trait profiles</i>	Uniform	Diverse	Uniform	Diverse
<i>Distribution</i>	Normal	Normal	Skewed	Extremely skewed
<i>Proportion ungifted</i>	Small	Extremely small	Large	Extremely large
<i>Familial inheritance</i>	Highest	High	Low	Lowest
<i>Growth trajectories</i>	Few	Numerous	Few	Numerous
<i>Growth onset</i>	Early	Earliest	Later	Latest
<i>Ease of Identification</i>	Highest	High	Low	Lowest
<i>Instruction / training strategies</i>	Few	Numerous	Few	Numerous

Caveats

- **Focus solely on nature**
- **Nurture no less critical, and probably more so**
- **Combining nature and nurture would render the phenomenon not simpler, but even more complex owing to nature-nurture interactions**

