Galton's Data a Century Later

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ABSTRACT: A century ago, Francis Galton obtained data from thousands of individuals on a variety of sensory, psychomotor, and physical attributes. A substantial portion of these data has remained unanalyzed. In this article, we report on the reliability of the measures, developmental trends in mean scores, correlations of the measures with age, correlations among measures, occupational differences in scores, and sibling correlations. Test–retest correlations generally were very substantial. Growth continued for some individuals, especially those from lower economic strata, until they were in their mid-20s. Developmental trends during later childhood, adolescence, and early maturity were found to be similar to those described in contemporary developmental psychological literature, except that the tempo of development appears to have been slightly slower then than now. Persons from lower economic strata were smaller and weaker and showed less sensory efficiency. In addition, analyses of variance indicated that persons from lower economic strata continued their physical growth longer than persons from more advantaged environments. Sibling resemblances were substantial on most of the measures; opposite-sex siblings resembled one another less than did same-sex siblings.

In 1884, Francis Galton established an anthropometric laboratory at the International Health Exhibition in South Kensington, London, "for the measurement in various ways of Human Form and Faculty" (quoted in Pearson, 1924, p. 359). In about one year, data were collected on 9,337 individuals. A similar laboratory, which operated for several years, was established in the Science Galleries of the South Kensington Museum in 1888. The purposes of these laboratories were described in a handbill as follows:

1. For the use of those who desire to be accurately measured in many ways, either to obtain timely warning of remediable faults in development, or to learn their powers.
2. For keeping a methodological register of the principal measurements of each person, of which he may at any future time obtain a copy under reasonable restrictions. His initials and date of birth will be entered in the register, but not his name. The names are indexed in a separate book.
3. For supplying information on the methods, practice, and uses of human measurement.
4. For anthropometric experiment and research, and for obtaining data for statistical discussion. (Pearson, 1924, p. 358)

Together, these laboratories represented the logical culmination of Galton's preoccupation—one might almost say obsession—with measurement. The polymathic Galton, who appears to have been interested in nearly everything, was persuaded that nearly everything was measurable: intellectual capacity, personality, beauty, the average flush of excitement, the boringness of lectures, and the efficacy of prayer, to name but a few things that came into his purview.

Galton's investigations were conducted in the very early days of the development of descriptive statistics. Quetelet's "law of deviation from an average" (the normal curve; Galton, 1892) had attracted much attention as being potentially applicable to a broad range of phenomena, and Galton was in the forefront of its application. Galton had himself invented the median and percentiles as means of expressing central tendency and variability. Galton was the first to express the concepts of reversion (later called regression) and correlation, based on his studies on inheritance.

In his studies, Galton had acquired a keen appreciation of the relationship between the stability of a statistic and sample size. For his various schemes, grand in concept and in breadth, he needed grand data sets, and he made a variety of efforts to obtain large sample data. The anthropometric laboratories were his best solution, providing data on approximately 17,000 individuals during the 1880s and 1890s. He had obviously solved the problem of large-scale data acquisition. However, the problem of analyzing this huge data set was not adequately

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solved. Koga and Morant (1923) published an article on the issue of correlation between visual and auditory reaction time, and several other studies used portions of the data. Ruger and Stoessiger (1927) analyzed Galton's data and presented growth curves regarding each of a number of attributes for over 7,000 male subjects. Elderton and Moul (1928) performed similar analyses for over 1,800 female subjects. Ruger (1933) presented age-corrected intercorrelations among eight of Galton's measures. Ruger and Pearson (1933) further developed the theoretical statistical implications of Ruger's original 1933 article. These articles are long, detailed, and highly informative. Hard work and dedication were needed to perform these analyses in the 1920s because there were no electronic calculators, much less computers. These studies used data from the first of Galton's laboratories. The present data were collected at his second laboratory in the South Kensington Museum.

Methods Used by Galton

Subjects

Each testee, typically a visitor to the museum, paid three pence (two pence for second or later testings) for his or her assessment. The testee received one copy of his or her measures, and Galton kept a second set. As would be expected of a group of paying testees being measured in a museum, a sizable portion of Galton's sample consisted of professionals, semiprofessionals, and students. However, as may be discerned in Tables 10 and 11, all socioeconomic strata were represented.

Approximately 7,500 individual data records still exist at the Galton Laboratory. Through the generosity of Harry Harris, then Professor of the Laboratory, we obtained photocopies of these records.

The change from English to metric measurement at case number 6,501, a change that apparently gave even Galton's assistants difficulties, raises some issues of interpretation of data entries after that point. This report is therefore limited to the first 6,500 cases. The sample size was further reduced by problems in the photographic reproduction of a few records. Thus, the sample on which the present analyses were conducted consists of 4,849 males and 1,639 females.

Measures

The subjects were measured on a variety of physical and functional dimensions. The former included head length, head breadth, standing height, sitting height, height to top of knee, arm span, length of lower arms, length of middle finger, and weight. The functional measures included strength of hand squeeze determined by dynamometer, breathing capacity (vital capacity) measured by spirometer, keenness of eyesight (visual acuity), highest audible tone,[1] reaction time to visual and to auditory stimuli, and speed of blow.

The dynamometer and spirometer were of the then-standard design. Instruments used for the other functional tests were Galton's inventions and require further description. Figure 1 is taken from Plates XII and XIII of Galton's 1885 report on the International Health Exhibition research. The portions of Figure 1 numbered 1 and 1a show the device used for assessing visual acuity. Text from the shilling "diamond" type edition of the Anglican Prayer Book was held at fixed distances and viewed through an aperture that assured a standard perspective for all subjects. This instrument seemed to be reasonably satisfactory, but Galton realized that the text was possibly too familiar to the subjects and later suggested that tables of logarithms could be substituted. The Snellen reading chart at 90 ft was also used for testing visual acuity.

Sections 5 and 5a in Figure 1 describe the apparatus for measuring swiftness of blow, which proved to be troublesome. An early version required the subject to punch a pad, thereby driving a rod along guides. A spring was released by the movement, and a pencil attached to the spring described a sinusoid path along paper, with the interpeak distance a function of the speed of movement of the bar. Galton was astonished at the ineptitude of many of the subjects, who delivered tangential rather than direct blows to the pad and consequently broke the rod. The final version of the device therefore involved a hand grip on a wire connected to the other end of the rod. The rod was thus pulled rather than pushed. (Sections 2, 3, and 4 of Figure 1 show devices for assessing color vision, line bisection, and judgment of the vertical, all used by Galton at the Health Exhibition but not in the data with which we are here concerned.)

Galton recognized that keenness of hearing, by which he meant auditory threshold, could not be ascertained with the ambient noise in the area of the laboratory. Therefore, Galton (1885) settled for a measure of highest audible tone. An India rubber

We thank Harry Harris for providing us with access to these data. Funds for photocopying these data were provided by Wytze Gorter, then Dean of the Graduate School of the University of Hawaii.

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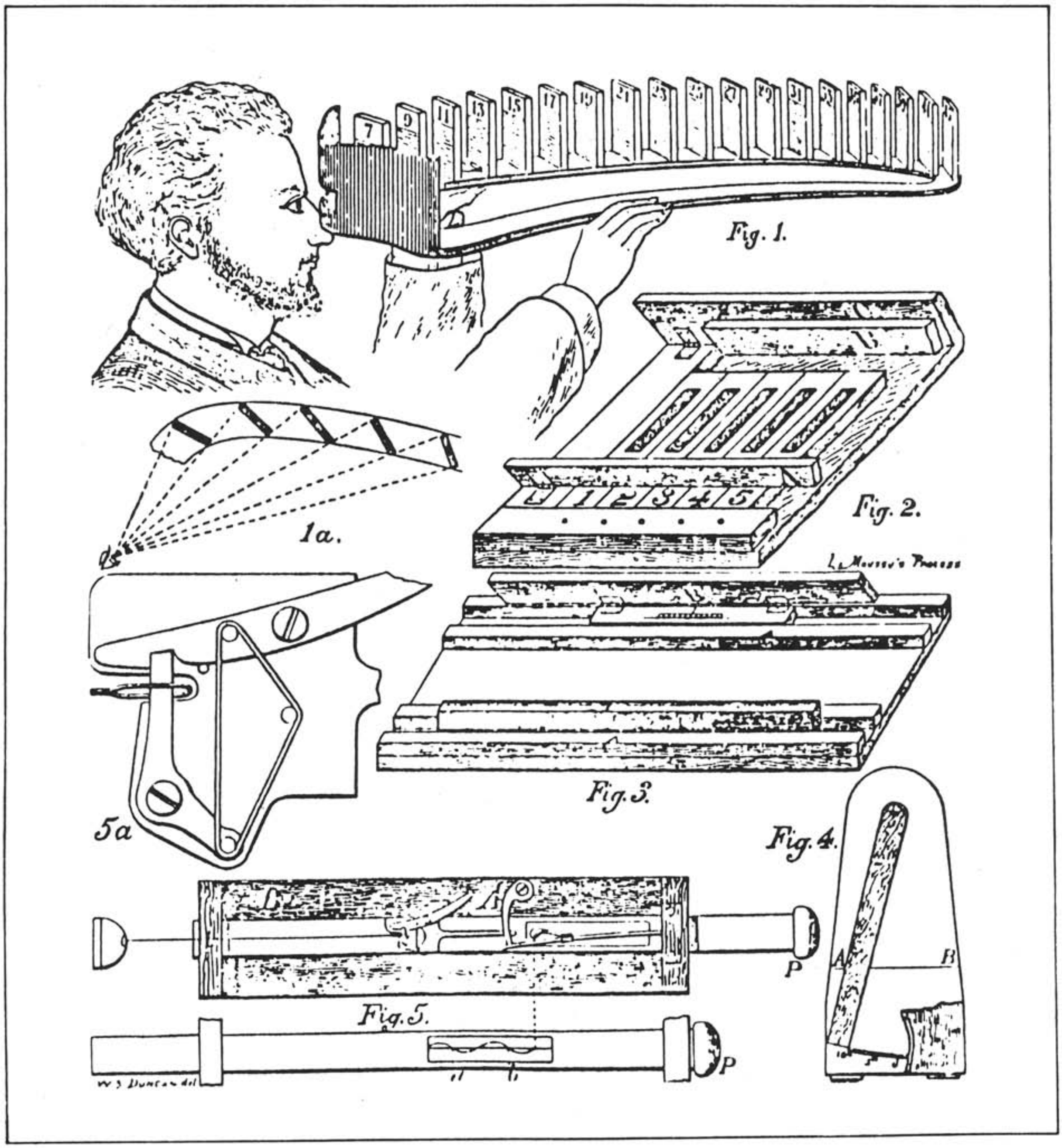
[1] Keenness of hearing also was measured by establishing whether subjects could distinguish between tones. Basically, it seems that this measurement established whether a subject was deaf; there was essentially no variance in this measure, and it is omitted from our presentation.

Figure 1
Examples of Galton's Measuring Devices



Note. From "On the Anthropometric Laboratory at the Late International Health Exhibition" by F. Galton, 1885, *Journal of the Anthropological Institute, 14*, pp. 205–219. In the public domain.

tube directed air puffs through one of five fixed whistles that emitted sound at 10, 20, 30, 40, or 50 thousand cycles per second. With the general limit determined in this way, a more precise upper threshold was determined by a variable whistle.

The instrument for measuring reaction time, a pendulum chronograph, was succinctly described by Koga and Morant (1923) as follows:

This consists of a fairly massive seconds pendulum, which can be released at an angle of 18° from the vertical;

during its descent the pendulum gives a sight-signal by brushing against a very light and small mirror which reflects a light off or onto a screen, or, on the other hand, it gives a sound-signal by a light weight being thrown off the pendulum by impact with a hollow box. The position of the pendulum at either of these occurrences is known. The position of the pendulum when the response is made is obtained by means of a thread stretched parallel to the axis of the pendulum by two elastic bands one above and one below, the thread being in a plane through the axes of the pendulum, perpendicular to the plane of the pendulum's motion. This thread moves freely between two parallel bars in a horizontal plane, and the pressing of a key causes the horizontal bars to clamp the thread. Thus the clamped thread gives the position of the pendulum on striking the key. The elastic bands provide for the pendulum not being suddenly checked on the clamping. The horizontal bars are just below a horizontal scale, 800 mm. below the point of suspension of the pendulum. Galton provided a table for reading off the distance along the scale from the vertical position of the pendulum in terms of the time taken from the vertical position to the position in which the thread is clamped. (p. 347)

As Jensen (1980) noted in his historical review of research on reaction time and intelligence, Galton was the first to suggest that simple reaction time might reflect general mental ability. Researchers since Galton's time have found only modest correlations between simple reaction time and tests of general intelligence, although reaction time involving more complex choices may be related to intelligence.

As noted above, each testee received a copy of the data obtained, and Galton kept a copy. One such record (Galton's own) is shown in Figure 2. (See Galton, 1908; Pearson, 1924; and Forrest, 1974 for further descriptions of Galton's laboratory and his measurement program.)

Results and Discussion

Reliability

Macey, Plomin, and McClearn (1979) reported the test–retest reliabilities for these measures on a sample of 50 subjects all tested twice within one month. In general, the reliabilities were quite high. We report the test–retest reliabilities in Table 1 for all of the subjects for whom test–retest data were obtained within one year, and in Table 2 for all subjects for whom test–retest data were available, whether or not the two tests occurred within one year of each other. If subjects were tested more than twice, we entered data from their first and last set of measure-

Figure 2
Representative Data Sheet; Data From Francis Galton

F Galton 12

Initials of: Self	Initials of: Father	Initials of: Mother	Father and mother first cousins?	Date of birth	Eye color	Sex	Married Single Widowed	Color sense	Occupation
FG	G	D	No	16 2 22	Light Blue	M	M	Normal	Private Gen.

Date of measurement (Day Month Year)	Head length maximum from root of nose (Inches Tenths)	Head breadth maximum (Inches Tenths)	Height standing less heels of shoes (Inches Tenths)	Span of arms from opposite fingertips (Inches Tenths)	Weight in ordinary clothing (Pounds)	Strength of squeeze: Right hand (Pounds)	Strength of squeeze: Left hand (Pounds)	Breathing capacity (Cubic inches)	Keenness of sight distance of reading diamond numerals: Right eye (Inches)	Keenness of sight distance of reading diamond numerals: Left eye (Inches)	Snellen's type read at 90 feet (Number of type)
21 2 88	7 1	6 1½	68 7	71 8	171	80	71	159	17	19	D9

Height sitting above seat of chair (Inches Tenths)	Height of top of knee when sitting less heels left arm (Inches Tenths)	Length of elbow to finger of left hand (Inches Tenths)	Length of middle finger of left hand (Inches Tenths)	Hearing: Keenness of hearing	Hearing: Highest audible note (Vibrations per second)	Reaction time: To sight (Thousandths of second)	Reaction time: To sound (Thousandths of second)
36.5	21.6	18.4	4.4				

Table 1
Test–Retest Reliability for Galton's Age-Corrected, With One Year or Less Between Testings

Measure	Total *N*	Total Retest correlation	Males *N*	Males Retest correlation	Females *N*	Females Retest correlation
Behavioral						
Keenness of eyesight (right)	415	.83	330	.83	85	.81
Keenness of eyesight (left)	414	.81	328	.82	86	.77
Snellen eye chart	241	.69	203	.69	38	.79
Highest audible tone	349	.28	284	.26	65	.43
Reaction time to sight	421	.21	332	.22	89	.11
Reaction time to sound	422	.24	333	.26	89	.15
Breath capacity	432	.89	341	.85	91	.77
Strength of squeeze (right)	431	.87	340	.82	91	.76
Strength of squeeze (left)	432	.82	340	.81	92	.46
Speed of blow	110	.51	96	.48	14	−.28
Physical						
Head length	433	.94	340	.93	93	.90
Head breadth	433	.97	340	.97	93	.94
Height	435	.98	342	.98	93	.98
Sitting height	431	.92	339	.92	92	.90
Height of knee[a]	230	.72	192	.70	38	.54
Armspan	435	.92	342	.88	93	.96
Length of middle finger	431	.96	338	.95	93	.96
Length of lower arm[b,c]	229	.98	191	.97	38	.98
Length of lower arm (right)[b]	202	.98	147	.97	55	.97
Length of lower arm (left)[b]	201	.98	147	.97	54	.97
Weight	437	.96	344	.96	93	.93

[a] Sole of foot to knee, while sitting. [b] Distance, end of elbow to end of middle finger. [c] Early subjects measured for one arm, later subjects for both arms.

ments. To prevent confounding of test–retest reliability with relative standing across age (i.e., stability of the measures), the data were age-corrected by regressing each measure on age and age squared, and the standardized residuals were calculated. When the measures are not age-corrected, the test–retest correlations are generally .02 to .05 higher than those reported in Tables 1 and 2. Data are reported for both sexes combined and separately for the two sexes.

As Macey et al. (1979) demonstrated earlier, Galton's measures generally were highly reliable. Exceptions are as follows:

1. "Height to top of knee" (distance from sole of foot to top of knee, while sitting) was not reliable. Galton changed the attribute measured from height of knee to "length of lower left arm" (distance from end of elbow to end of middle finger) midway through his test series, putting the two measures in the same space on his data sheet, while a second data entry "length of lower arm" was changed to "length of lower right arm." At least some of the unreliability of this measure almost certainly comes from the failure of Galton's assistants to change the reported measure properly or from our problems in data entry arising from the shift of scale. Because knee height was measured only for early subjects, but length of lower arm was measured for all subjects, the errors would not be reciprocal—hence the high reliabilities of length of lower arm.

2. Visual and auditory reaction times were also unreliable. It is now well established (e.g., Jensen, 1980) that a reliable measure of reaction time can be obtained only when many separate measures of reaction time are taken in a given test series. As far as we can ascertain, Galton took only a single measure each of visual and of auditory reaction times.

3. The relatively low reliability of speed of blow may be due to the instrumentation problems described previously.

4. We have no explanation for the comparatively low reliabilities of highest audible tone. Instrumentation problems as well as ambient noise may have resulted in random variation.

5. Inconsistencies in the ways in which Galton's

assistants entered the data led to the Snellen measure's being lower in reliability than the measures of diamond type. Because the diamond type measure was the more reliable of the two measures, was administered to more subjects, and also was used to test each eye separately (as opposed to a binocular measure of the Snellen type), we hereafter report visual acuity in terms of diamond type.

In general, Galton's data seem to be quite reliable. Some of the test-retest reliabilities of measures are lower than the correlations of scores on these measures with age or with one another. It is entirely possible (see Ghiselli, 1964, pp. 271–272) for a variable to have a correlation with another variable that is higher than its own reliability, as long as the other variable is reliably measured (e.g., as we can assume was the case with regard to age). It also is possible for a variable to be precisely measured on one occasion but to have low test-retest reliability. Hence, it is possible for two measures low in test-retest reliability (e.g., visual and auditory reaction times) to correlate highly with one another, using measures taken on a single occasion.

Developmental Trends and Age Correlations

The wide range of Galton's subjects invites developmental analysis. Any such analysis is, of course, limited by the fact that the data are cross-sectional and subject, therefore, to all the appropriate limitations of interpretation, because age effects and cohort effects are necessarily confounded.

As will be discussed later, our analyses indicate that among persons from lower economic groups, there was evidence of continued physical growth through the mid-20s. Therefore, our analyses are separate for subjects aged 11 (the lowest age with a reasonably large number of subjects) through 25 and 26 through 84 (Galton's oldest subject). This is a somewhat arbitrary cutting point, but it separates the period of growth from that of maturity and (for a number of measures) decline. Mean scores for males and for females, aged 11 to 25 and 26 to later maturity are shown in Tables 3 and 4. These tables already are very long. The inclusion of units of measurement would necessarily lengthen them substantially. Therefore, the units are not included in

Table 2
Age-Corrected Test–Retest Reliabilities for All Subjects Retested

	Total		Males		Females	
Measure	*N*	Retest correlation	*N*	Retest correlation	*N*	Retest correlation
Behavioral						
Keenness of eyesight (right)	1,142	.79	973	.79	169	.77
Keenness of eyesight (left)	1,135	.76	965	.76	170	.74
Snellen eye chart	821	.58	718	.57	103	.65
Highest audible tone	1,064	.28	912	.28	152	.29
Reaction time to sight	1,069	.17	992	.16	177	.21
Reaction time to sound	1,172	.18	994	.18	178	.20
Breath capacity	1,195	.86	1,014	.82	181	.74
Strength of squeeze (right)	1,193	.81	1,012	.75	181	.76
Strength of squeeze (left)	1,191	.77	1,010	.71	181	.61
Speed of blow	204	.49	179	.41	25	.04
Physical						
Head length	1,202	.93	1,019	.93	183	.85
Head breadth	1,203	.94	1,020	.94	183	.87
Height	1,205	.88	1,022	.86	183	.91
Sitting height	1,201	.87	1,019	.86	182	.86
Height of knee[a]	808	.58	702	.55	105	.41
Armspan	1,202	.89	1,019	.86	183	.92
Length of middle finger	1,196	.88	1,013	.86	183	.89
Length of lower arm[b,c]	806	.88	701	.84	105	.89
Length of lower arm (right)[b]	390	.94	312	.93	78	.93
Length of lower arm (left)[b]	389	.94	312	.93	77	.92
Weight	1,207	.89	1,024	.88	183	.87

Note. Includes all subjects for whom test-retest data were available.
[a] Sole of foot to knee, while sitting. [b] Distance, end of elbow to end of middle finger. [c] Early subjects measured for one arm, later subjects for both arms.

Tables 3 and 4; the reader is referred to Tables 10 and 11, which present information regarding the same measures and in which the units of measurement are shown.

Correlations of scores with age are shown in Table 5 separately for the 11 to 25 and the 26+ age groups of males and females. Correlations of the measures are shown for both age and age squared (with age partialed out), in order to assess possible curvilinearity of associations.

The mean scores having to do with physical measures suggest that females show a maximal growth spurt from ages 12 through 14, males from 13 through 16. Mean scores in the age 26 and over group show a decline in sensory efficiency, physical strength, and reaction time. As shown, the partial correlations with age squared indicate more rapid early growth as opposed to late growth in the group aged 11 to 25 and accelerated decline of performance with increasing age in the age 26 or over group. For the 11 to 25 age group, z-tests indicated that the correlations with age for males were significantly greater (.001 level for 13 measures, .05 level for one more) than those for females on all measures except keenness of eyesight, highest audible tone, and the two reaction time measures. The large Ns make it unlikely that these results are due to chance. There are only two significant sex differences in the magnitude of correlations of the measures with age in the group of subjects aged 26 and older, with one correlation significantly higher for males than females and the other in the opposite direction.

The correlational data for the 11- to 25-year-olds indicate (not surprisingly) a positive association between age and physical stature, strength of squeeze, and breathing capacity. The correlations of age and visual acuity are not significant, indicating that there is no change in these measures during this period of development. The correlations of age with visual and auditory reaction times are negative, indicating that older persons within this age group have quicker reaction times. The only sign of decline is in highest audible tone heard, where even in this young age range there is a decrease with age in the frequencies of audible tones heard.

Of particular note in the correlations with age for the subjects aged 26 and older is the significant decline in sensory acuity, reaction time (increased time), breathing capacity ("vital capacity"), strength of squeeze, and speed of blow. It should be noted that very few subjects from the large sample—less than 400 in all—were above age 45. If subjects had been distributed more equally across the total age range, the magnitude of the negative correlations of sensory acuity and breathing capacity and the positive associations of reaction time with age might have been increased.

One particular aspect of the results involving the anthropometric measures is puzzling and requires elucidation. There is good reason to believe (see Boyd, 1980; Tanner & Tayler, 1971) that cohort changes in height and other aspects of physical size occurred during the period (approximately 1800 through 1870) in which the subjects age 26 and older were born, yet the correlations with age are quite low. Such a secular trend had been noted even during Galton's time. Bertillon, in 1885, noted Sidenbladh's 1876 finding that Swedish army recruits had increased in height between 1841 and 1875. Bertillon also noted that recruits from the low countries had grown taller, a result he presumed to be the result of the draining of the marshes and improved living conditions (Boyd, 1980, p. 477). Head length and head breadth were positively correlated with age for these subjects, but there was little in the way of negative correlation of age with stature, as would be expected from secular change in height. The obtained positive correlation between age and head length and breadth suggests differential survivorship of small versus larger persons, with larger persons having some sort of selective advantage. If larger persons are more likely to survive across decades, then any cross-sectional data (such as Galton's) underestimate the secular trends toward increased height that appear to have been present in Western culture for about the last 200 years.

Intercorrelations Among the Measures

The correlations shown in Table 5 indicated some substantial associations of scores with age among adults 26 years of age or older. We wished to establish the correlation between measures independent of age. Therefore, performance of each subject in each measure was corrected for age through the regression procedures described above. Correlations among age-corrected behavioral and physical measures were computed separately for males and for females and are presented in Tables 6 and 7. Correlations were computed based on pairwise deletion of missing data, and therefore sample sizes vary. Correlations were computed for only those subjects who were 26 years of age or older in order to minimize growth-related variations. As can be seen, the correlations among physical measures are positive and range from moderate to high for both males and females. For physical measures, correlations computed for males are generally greater than those computed for females. Of the 76 nonredundant intercorrelations among all the measures except keenness of eyesight, highest audible tone, and reaction time, z-tests indicated that 28 of the male correlations were significantly greater ($p < .05$) than the corresponding female correlations, whereas only two of the female correlations were significantly

Table 3
Mean Scores on Galton's Measures for Males Aged 11 Through 60+

Measure	Age 11 (N = 81)	12 (N = 101)	13 (N = 161)	14 (N = 189)	15 (N = 196)	16 (N = 230)	17 (N = 299)	18 (N = 363)	19 (N = 368)	20 (N = 345)	21 (N = 268)
Keenness of eyesight[a]											
Right eye	20.02	18.71	19.53	19.64	20.32	20.57	20.46	20.43	20.89	20.10	20.42
Left eye	19.71	19.24	19.81	19.70	20.24	20.73	20.56	20.57	20.95	20.46	20.57
Highest audible tone	21,550	20,980	21,670	21,460	21,080	21,190	21,170	20,680	20,530	20,580	20,370
Reaction time to sight	.201	.203	.195	.189	.190	.183	.185	.181	.182	.181	.183
Reaction time to sound	.174	.163	.161	.156	.156	.153	.153	.151	.150	.152	.149
Breathing capacity	115.51	123.92	131.24	151.99	176.51	197.31	213.79	230.86	230.19	229.66	229.79
Squeeze right hand	33.11	37.53	40.12	48.68	57.99	67.41	73.94	78.25	80.07	80.19	81.12
Squeeze left hand	30.75	35.36	38.04	45.72	54.75	63.14	69.58	73.99	75.90	75.25	75.82
Speed of blow	15.45	15.84	16.41	17.18	18.34	18.58	19.27	19.81	19.54	19.30	19.66
Head length	7.26	7.33	7.33	7.41	7.48	7.52	7.58	7.63	7.64	7.65	7.65
Head breadth	5.76	5.80	5.79	5.83	5.85	5.94	5.94	5.97	5.98	6.00	5.99
Height	55.38	57.50	58.37	61.39	64.10	65.88	66.97	67.69	67.41	67.34	67.51
Sitting height	29.24	30.03	30.55	31.88	33.24	34.31	35.02	35.64	35.65	35.63	35.70
Height to knee[b]	17.31	18.40	18.49	19.51	20.11	20.51	20.59	20.81	20.61	20.41	20.60
Span of arms	55.88	58.21	59.26	62.36	65.61	67.51	68.76	69.64	69.36	69.33	69.62
Length of middle finger	3.72	3.84	3.91	4.15	4.35	4.45	4.52	4.54	4.53	4.51	4.52
Length, lower arm[c]	14.72	15.50	15.71	16.59	17.33	17.81	17.96	18.15	18.10	17.95	18.11
Weight	76.51	82.66	89.54	101.04	114.62	125.40	133.34	140.00	141.70	141.27	142.57
Height/weight ratio	.74	.70	.67	.62	.57	.53	.51	.49	.48	.48	.48

[a] Subjects who were unable to read any of the cards were excluded. (The closest card was at a distance of six inches.) Through age 45, less than 8% of the males were unable to read any of the cards, but for males aged 46 to 60, the percentage climbed to 39% (right eye) and 37% (left eye). For males aged 51 to 60, the percentages were 57% and 53%, and for those aged 60 and over, 76% and 72%. [b] Height was measured from the sole of the foot to the knee, while sitting. [c] Distance from elbow to the end of the middle finger.

Table 4
Mean Scores on Galton's Measures for Females Aged 11 Through 60+

Measure	Age 11 (N = 21)	12 (N = 43)	13 (N = 38)	14 (N = 39)	15 (N = 48)	16 (N = 68)	17 (N = 76)	18 (N = 73)
Keenness of eyesight[a]								
Right eye	19.20	18.14	19.62	20.36	20.37	19.61	19.36	22.00
Left eye	18.86	18.52	19.83	21.03	20.96	19.66	19.57	22.20
Highest audible tone	21,090	21,200	22,800	21,080	20,560	20,530	20,790	21,150
Reaction time to sight	.219	.194	.213	.195	.188	.196	.189	.187
Reaction time to sound	.188	.168	.178	.170	.155	.160	.161	.155
Breathing capacity	98.86	115.19	122.29	136.69	132.92	135.73	142.46	149.05
Squeeze right hand	29.43	33.88	38.82	46.90	47.29	47.63	49.91	54.99
Squeeze left hand	26.52	30.93	35.70	43.82	42.82	44.10	46.00	51.85
Speed of blow	11.60	13.38	13.94	14.69	14.00	14.75	14.84	15.15
Head length	7.12	7.21	7.19	7.26	7.23	7.24	7.29	7.31
Head breadth	5.55	5.67	5.67	5.76	5.76	5.72	5.71	5.77
Height	55.20	58.31	60.46	61.93	62.64	62.51	63.19	64.06
Sitting height	29.23	30.79	31.72	32.75	33.33	33.32	33.81	34.19
Height of knee[a]	17.33	18.11	18.94	19.10	19.12	19.11	19.44	19.24
Span of arms	54.94	58.33	60.82	62.46	63.25	63.03	63.50	64.31
Length of middle finger	3.71	3.93	4.08	4.18	4.12	4.15	4.17	4.23
Length, lower arm[b]	14.47	15.28	15.70	16.07	16.20	16.34	16.59	16.64
Weight	77.67	85.37	94.60	106.97	111.44	117.51	120.60	129.85
Height/weight ratio	.73	.69	.65	.59	.57	.54	.53	.50

Note. *N*s over age 40 were too small for meaningful comparisons.
[a] Subjects who were unable to read any of the cards were excluded. [b] Height was measured from the sole of the foot to the knee, while sitting. [c] The distance was measured from the elbow to the end of the middle finger.

Age										
22 (*N* = 215)	23 (*N* = 183)	24 (*N* = 141)	25 (*N* = 126)	26–30 (*N* = 513)	31–35 (*N* = 297)	36–40 (*N* = 177)	41–45 (*N* = 146)	46–50 (*N* = 123)	51–60 (*N* = 121)	60+ (*N* = 74)
20.34	20.28	19.36	19.39	19.51	19.54	18.15	18.78	18.51	15.35	12.57
20.37	19.99	19.63	19.94	20.00	19.57	18.49	19.30	17.93	16.17	12.53
20,380	20,270	20,000	19,510	19,310	18,470	17,400	16,210	14,510	13,360	11,780
.185	.180	.188	.184	.181	.181	.185	.188	.189	.185	.209
.153	.155	.154	.151	.150	.154	.154	.156	.153	.154	.166
229.37	229.51	233.24	227.27	230.94	230.85	223.35	212.42	206.60	194.03	167.70
80.46	79.86	81.36	82.27	81.31	81.53	82.07	79.31	77.46	74.42	66.51
76.39	75.68	76.99	77.54	77.46	77.61	76.81	74.51	73.02	68.76	61.77
19.48	19.36	19.24	20.56	19.58	19.23	19.28	19.37	18.51	18.57	16.96
7.64	7.64	7.64	7.66	7.68	7.70	7.70	7.73	7.77	7.74	7.77
5.98	5.99	5.99	5.99	6.03	6.07	6.05	6.08	6.11	6.09	6.13
67.25	67.10	67.57	66.94	67.41	67.57	67.41	67.33	67.04	67.08	67.48
35.63	35.60	35.71	35.55	35.72	35.80	35.73	35.48	35.73	35.48	35.44
20.44	20.39	20.46	20.32	20.64	20.55	20.60	20.65	20.50	20.43	20.90
69.35	69.25	69.59	69.14	69.58	69.59	69.49	69.58	69.06	69.08	69.14
4.49	4.52	4.55	4.53	4.55	4.55	4.57	4.56	4.55	4.56	4.60
17.93	18.02	18.08	17.87	18.15	18.09	18.15	18.15	17.94	17.92	18.12
144.76	141.22	144.64	143.87	146.69	152.62	157.73	159.49	162.99	162.92	166.27
.48	.48	.47	.47	.46	.45	.43	.43	.42	.42	.41

Age									
19 (*N* = 98)	20 (*N* = 85)	21 (*N* = 81)	22 (*N* = 91)	23 (*N* = 80)	24 (*N* = 78)	25 (*N* = 67)	26–30 (*N* = 235)	31–35 (*N* = 133)	36–40 (*N* = 76)
19.62	21.07	20.48	19.40	20.44	20.70	20.71	19.12	19.29	17.04
19.80	21.05	20.92	19.13	21.32	20.96	21.09	19.00	19.70	17.51
20,800	20,670	20,990	20,060	20,050	20,490	20,170	19,930	19,160	18,090
.187	.184	.190	.185	.181	.185	.188	.189	.201	.194
.156	.156	.156	.162	.153	.153	.158	.157	.156	.156
151.61	150.86	149.74	147.60	146.86	146.06	143.79	143.14	145.30	137.64
53.29	53.34	53.94	51.81	53.32	52.39	52.27	52.75	50.99	48.09
50.90	51.68	51.16	49.78	48.40	49.58	47.81	49.85	47.95	45.33
15.05	15.41	15.24	14.73	15.12	14.04	14.26	15.55	14.73	14.27
7.30	7.28	7.27	7.26	7.29	7.28	7.27	7.27	7.27	7.30
5.78	5.76	5.73	5.74	5.75	5.77	5.77	5.77	5.80	5.77
63.84	64.03	63.65	63.85	63.81	63.47	63.76	63.51	63.57	62.75
34.06	34.17	33.93	33.99	34.01	33.81	34.03	34.00	34.04	33.70
19.25	19.36	19.39	19.53	19.31	19.15	19.16	19.16	19.29	19.02
63.97	64.26	63.98	63.67	63.80	63.76	64.12	63.47	63.49	62.68
4.20	4.23	4.20	4.20	4.22	4.20	4.22	4.19	4.19	4.15
16.60	16.62	16.61	16.63	16.43	16.45	16.46	16.43	16.52	16.30
125.85	128.52	124.48	126.23	126.21	123.35	126.10	126.10	127.73	125.88
.51	.50	.52	.51	.51	.52	.51	.51	.51	.51

Table 5

Correlations With Age and Partial Correlations With Age Squared

	Age 11–25						Age 26+					
	Male			Female			Male			Female		
	Age	Age squared	*N*	Age	Age squared	*N*	Age	Age squared	*N*	Age	Age squared	*N*
Keenness of eyesight[a]												
Right eye	.01	−.06***	3,180	.07*	−.04	950	−.17***	−.07	1,186	−.17***	−.03	501
Left eye	.02	−.06***	3,139	.07*	−.03	945	−.18***	−.07	1,184	−.17***	−.05	507
Highest audible tone	−.15***	−.01	3,045	−.11***	−.01	891	−.57***	.02	1,356	−.53***	−.02	525
Reaction time to sight	−.09***	.11***	3,249	−.15***	.08*	981	.16***	.06*	1,438	.12**	−.04	588
Reaction time to sound	−.09***	.11***	3,249	−.15***	.10***	980	.10***	.04	1,436	.03	−.00	588
Breathing capacity	.59***	−.43***	3,258	.26***	−.24***	982	−.38***	−.10***	1,445	−.30***	−.12**	590
Squeeze right hand	.65***	−.47***	3,259	.39***	−.34***	982	−.26***	−.13***	1,445	−.29***	.02	587
Squeeze left hand	.64***	−.45***	3,260	.38***	−.36***	981	−.29***	−.11***	1,443	−.26***	−.03	586
Speed of blow	.40***	−.26***	1,115	.11	−.23***	336	−.24***	−.06	451	−.41***	−.04	213
Head length	.36***	−.21***	3,264	.09**	−.09**	984	.12***	−.03	1,448	.21***	.03	588
Head breadth	.28***	−.14***	3,264	.13***	−.09**	984	.13***	−.02	1,448	.14***	.10*	588
Height	.57***	−.53***	3,264	.41***	−.39***	984	−.04	−.01	1,449	−.06	.06	590
Sitting height	.64***	−.54***	3,257	.45***	−.46***	982	−.07**	−.03	1,447	−.11*	.03	590
Height of knee[b]	.35***	−.42***	1,796	.24***	−.28***	513	−.00	.05	816	.06	.02	286
Span of arms	.59***	−.53***	3,262	.36***	−.37***	984	−.06*	−.00	1,445	−.08*	.06	588
Length of middle finger	.52***	−.47***	3,257	.28***	−.25***	983	.04	.01	1,448	.04	.07	586
Length of lower arm[c]	.49***	−.49***	1,800	.34***	−.39***	513	−.06	.03	819	.09	.07	286
Weight	.60***	−.42***	3,263	.49***	−.45***	984	.28***	−.11***	1,448	.22***	.03	589
Height/weight ratio	−.65***	.51***	3,263	−.53***	.51***	984	−.30***	.12***	1,448	−.23***	−.20	589

Note. Age was partialled out of the age squared correlations.
[a] Subjects who were unable to read any cards were excluded. [b] Height was measured from the sole of the foot to the knee, while sitting. [c] The distance was measured from the elbow to the end of the middle finger.
* $p < .05$. ** $p < .01$. *** $p < .001$.

greater than the male correlations. With only a few exceptions, correlations among behavioral measures are generally low and nonsignificant for both males and females. Breathing capacity is moderately correlated with all physical variables and with most other behavioral measures. Correlations involving sensory acuity and physical variables are for the most part low and nonsignificant for both males and females.

In order to obtain some clarification of the underlying structure of these correlation matrices, a principal components analysis was performed on the correlation matrices computed separately for males and females, using listwise deletion of missing data. Principal component analysis was chosen because of the exploratory nature of this analysis and because no a priori selection of variables was made that would be expected to adequately define common factors. In order to maintain adequate sample sizes for these matrices, we omitted knee height. Prelim-

Table 6
Correlations of Age-Corrected Anthropometric and Sensory Scores of Males Age 26 or Older

Measure	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
1. Keenness of eyesight (right eye)	—	79	04	−07	−02	11	09	07	03	02	05	06	04	05	03	−01	03	05
2. Keenness of eyesight (left eye)		—	06	−07	−04	12	10	08	05	02	03	05	05	03	03	−00	02	05
3. Highest audible tone			—	−05	−10	−04	01	03	−03	−02	−02	−00	−01	02	−02	−03	−01	01
4. Reaction time to sight				—	50	−15	−16	−13	−26	−01	−01	−15	−15	−11	−13	−07	−12	−11
5. Reaction time to sound					—	−17	−22	−19	−24	−08	−07	−17	−18	−13	−16	−09	−12	−15
6. Breathing capacity						—	52	48	32	27	19	62	58	52	59	45	54	43
7. Strength of right hand grip							—	80	32	29	24	56	53	49	59	52	53	57
8. Strength of left hand grip								—	24	27	22	51	48	47	55	50	53	52
9. Speed of blow									—	08	05	30	24	—	31	19	—	18
10. Head length										—	34	31	35	24	29	29	25	40
11. Head breadth											—	21	24	18	19	15	18	34
12. Height standing												—	82	82	86	67	80	60
13. Height sitting													—	60	69	57	63	61
14. Knee height														—	82	66	81	53
15. Armspan															—	77	92	56
16. Length of middle finger																—	82	45
17. Length of lower left arm																	—	49
18. Weight																		—

Note. Correlations were based on pairwise deletion of missing data. Correlations were omitted when the number of pairs was less than 10; for correlations of speed of blow with other variables N = 428–494; for correlations of knee height and elbow length with other variables N = 872–888; for all other correlations N = 1470–1576. Underlined correlations were not significantly different from zero.

Table 7
Correlations of Age-Corrected Anthropometric and Sensory Scores of Females Age 26 or Older

Measure	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
1. Keenness of eyesight (right eye)	—	82	02	−11	−06	05	08	06	10	−01	03	08	07	08	08	03	04	−01
2. Keenness of eyesight (left eye)		—	06	−09	−07	03	06	05	03	−02	00	07	06	05	07	03	−00	01
3. Highest audible tone			—	−05	−10	05	10	08	−04	−02	02	10	08	09	06	07	04	02
4. Reaction time to sight				—	54	−12	−08	−05	−11	01	05	−07	−08	−02	−05	−00	−06	−08
5. Reaction time to sound					—	−21	−15	−15	−08	−04	−01	−12	−13	−08	−10	−02	−10	−09
6. Breathing capacity						—	43	39	27	28	13	55	46	46	53	44	47	24
7. Strength of right hand grip							—	75	16	28	06	43	38	41	50	49	43	35
8. Strength of left hand grip								—	15	24	03	35	33	39	44	45	44	32
9. Speed of blow									—	05	−10	14	11	—	09	04	—	00
10. Head length										—	23	33	31	29	34	31	34	33
11. Head breadth											—	13	11	14	13	11	11	20
12. Height standing												—	82	87	87	72	81	49
13. Height sitting													—	59	64	58	58	49
14. Knee height														—	81	64	77	50
15. Armspan															—	77	87	47
16. Length of middle finger																—	81	39
17. Length of lower left arm																	—	39
18. Weight																		—

Note. Correlations were based on pairwise deletion of missing data. Correlations were omitted when the number of pairs was less than 10; for correlations of speed of blow with other variables N = 180–238; for correlations of knee height and elbow length with other variables N = 316–319; for all other correlations N = 572–657. Underlined correlations were not significantly different from zero.

inary analyses of the correlation matrix, based on the sample ($N = 533$) that has no missing data, indicated that four principal components had eigenvalues equal to or greater than one and could be retained for rotation (Kaiser, 1958). Therefore, these four components were extracted for the male and female matrices and subjected to orthogonal (varimax) rotation. Varimax component loadings for the age-adjusted variables are shown for males in Table 8 and for females in Table 9. The four components account for 66% of the variance for males and 65% of the variance for females. Congruence coefficients (Tucker, 1951) between males and females are .99, .94, .92 and .98 for components 1 through 4, respectively. Component 1 has highest loadings for the various physical variables relating to bone length, and therefore this component has been labeled body length. Component 2 appears to be principally determined by reaction time and speed of blow and has been labeled reaction time. Component 3 is almost exclusively defined by the two keenness of eyesight variables and is labeled visual acuity. The highest loadings for component 4 involve variables related to body breadth or size, such as head length, head breadth, weight, and breathing capacity; therefore, this component is tentatively labeled body breadth.

Table 8

Varimax Component Loadings of Age-Adjusted Anthropometric and Sensory Variables Obtained From Males

Variable	Component loadings			
	1	2	3	4
Behavioral				
Keenness of eyesight (right eye)	07	04	93	03
Keenness of eyesight (left eye)	05	02	93	02
Highest audible tone	08	07	−09	−17
Reaction time to sight	−11	88	06	−08
Reaction time to sound	−04	88	07	−04
Breathing capacity	62	−18	12	21
Strength of right hand grip	67	−24	05	30
Strength of left hand grip	64	−17	−01	26
Speed of blow	32	−47	12	−14
Physical				
Head length	36	02	−10	58
Head breadth	12	06	02	76
Height standing	90	−12	05	12
Height sitting	73	−12	−01	30
Armspan	94	−06	07	−04
Length of middle finger	86	01	−05	−10
Length of lower right arm	94	−06	01	−05
Length of lower left arm	94	−05	−03	−09
Weight	64	05	−05	43

Note. N = 345. Decimals were omitted.

Relationship to Socioeconomic Status

Throughout the late 1800s there was considerable interest among researchers in the relationship between social class and various anthropometric measures. Upper class subjects were typically found to have a higher mean height, weight, and vital capacity than their lower class counterparts, and these results were often discussed in terms of the effects of heredity and environment. Henry Pickering Bowditch's 1877 study noted the differences between the laboring and nonlaboring classes, and he concluded that the physical superiority of the latter seemed to

Table 9

Varimax Component Loadings of Age-Adjusted Anthropometric and Sensory Variables Obtained From Females

Variable	Component loadings			
	1	2	3	4
Behavioral				
Keenness of eyesight (right eye)	06	−02	95	−01
Keenness of eyesight (left eye)	07	−04	92	−04
Highest audible tone	04	37	01	−10
Reaction time to sight	−02	88	−00	02
Reaction time to sound	02	85	00	−10
Breathing capacity	67	−14	12	02
Strength of right hand grip	49	−31	19	33
Strength of left hand grip	48	−23	18	35
Speed of blow	25	−26	14	−13
Physical				
Head length	27	07	−05	64
Head breadth	−01	09	02	79
Height standing	93	−08	00	06
Height sitting	79	−03	−07	12
Armspan	93	−04	08	16
Length of middle finger	85	08	02	18
Length of lower right arm	94	−00	03	16
Length of lower left arm	93	−00	02	16
Weight	46	02	−13	59

Note. N = 164. Decimals were omitted.

"depend partly on the greater average comfort in which such children live and grow up, and partly upon differences of race and stock" (quoted in Boyd, 1980, p. 469). After looking at J. H. Baxter's 1875 American data, Bowditch further stated that it was "safe to conclude that the importance of mode of life, as a factor in determining the size of growing children in this community, is at least equal to, and possibly even greater than that of race" (quoted in Boyd, 1980, p. 469). Another important study cited by Boyd is that of Luigi Pagliani, who, in 1879, also found the well-to-do to be larger and heavier and to have a greater vital capacity than the poor, although poor farmers were found to be stronger than city dwellers.

The British Anthropometric Committee, appointed in 1875, also examined social class differences. Members of this committee included Francis Galton, Charles Roberts, and Rawson W. Rawson. As in our data presentation, the committee assigned subjects to classes on the basis of their stated occupation. The classification scheme was as follows: Class I—professional (upper and upper middle classes); Class II—commercial (lower middle class), clerks and shopkeepers; Class III—agricultural laborers, gardeners, miners, sailors, fishers; Class IV—artisans, workers in wood, metals, and stone, engravers, and printers; and Class V—sedentary occupations, such as factory workers, shoemakers, and tailors.

Roberts and Rawson's 1884 report (cited in Boyd, 1980) summarized the results of analyses on data collected from 38,000 males and 4,500 females ranging in age from birth to 70 years. Based on the Anthropometric Committee's classification, 24-year-old males in Classes I, II, III, and IV were found to have mean heights of 68.73, 67.42, 67.38, and 66.40 inches, with an overall mean of 67.48 inches, whereas 24-year-old females in Classes I, II, and IV were found to have mean heights of 63.42, 62.66, and 61.81 inches. The mean weights for 24-year-old males in Classes I to IV were 151.5, 146.8, 152.8, and 140.2 pounds, with an overall mean of 147.8 pounds, whereas 24-year-old females in Classes I and II had mean weights of 128.7 and 119.4 pounds. Although adult heights and weights thus showed a clear social class effect, such was not the case for growth increments on these variables. For males under 25 years of age in Classes I to IV the maximal increment in heights and the ages at which this occurred were 2.62, 2.72, 3.88, and 2.80 inches at 16, 15, 15, and 14 years of age, with an overall mean of 2.91 inches at 15 years. The corresponding maximal height increments and ages for females under 25 years of age were 2.37, 2.79, 3.11, and 2.58 inches at 12, 13, 12, and 11 years of age, with an overall mean of 2.56 inches at 12 years of age. For males under 25 years of age in Classes I to IV, the maximal increment in weight and the age at which this occurred were 15.2, 17.8, 16.6, and 15.8 pounds, all at 16 years of age, with an overall mean increment of 16.3 pounds; the corresponding maximal weight increments and ages for females under 25 years of age were 10.1, 10.9, 10.0 and 12.8 pounds at 14, 14, 15, and 15 years of age, with an overall mean of 10.8 pounds at 14 years of age (above data from Boyd, 1980, p. 476).

Each subject tested in Galton's anthropometric laboratory provided information regarding his or her occupation. This information was entered on each subject's data sheet. An examination of the first several hundred records indicated that it was possible to categorize the subjects into seven groups for our analyses on the relation of socioeconomic status to anthropometric and sensory measures. The categories were as follows: (a) professional (physicians, surgeons, solicitors, barristers, professors, scientists, high-level civil servants); (b) semiprofessional (teachers, engineers [who in Galton's era were of a lower educational level and status than at present], chemists [that is, pharmacists], and similar occupational groupings) and skilled tradespeople (e.g., goldsmiths, jewelry makers, electricians, cabinet makers, shipwrights, etc.); (c) merchants and proprietors (including the few farmers who found their way to Galton's laboratory); (d) clerical workers, small shopkeepers, and semiskilled workers (e.g., hosiery makers, drapers, waiters, etc.); (e) unskilled workers (laborers, "draymen," carters, private members of the armed forces, delivery people, servants); (f) "gentlemen" and "ladies"; Galton himself served as a subject in the anthropometric laboratory (see Figure 2) and listed his occupation as "private gentleman" (in our view, a most enviable occupation); because he was not alone, we included this occupational type as a separate category; (g) "student" or "scholar"; as would be expected at a museum, many visitors were young people, who were accompanied by their teachers. These were clearly "students" or "scholars." As the age distributions of students/scholars makes clear, a number of older persons also listed themselves as one or the other. The data presented herein suggest that the older "students" and "scholars" of the present sample usually were persons like Galton—people of independent means who devoted their lives to scholarship.

There also was the category of "unemployed," scored as "0". If one is coding data, one must accept the data provided. Unemployed is unemployed, and perhaps some of those persons who described themselves as unemployed were out of work and looking for a job. On the other hand, marginal notes on the data sheets indicate that at least some of the unemployed were members of the nobility (and, probably, at least one of them a member of the royalty). The term *unemployed* apparently did not have the same dismal connotation in England a century ago that it has in the United States. Witness Sebastian Moran[2] who, in 1894 (while the present data were being gathered) was (a) Colonel, formerly of the 1st Bangalore Pioneers, (b) the best heavy game hunter of the Eastern Empire, (c) educated at Eton and Oxford, (d) the second most dangerous man in London, and (e) "unemployed" (see Doyle, 1903/1975). Categories 6 (gentlemen), and a portion of 0 (unemployed) as well as the adult members of category 7 (student/scholar) seem to describe members of the same social class, insofar as the male subjects are concerned.

In the categorization of subjects according to the occupation listed, some errors seem to have occurred. It is difficult to believe that, in fact, two members of the 11- to 15-year-old cohort actually were professionals, as the computer printout indicated. An examination of the data sheets strongly suggests that Galton's assistants tended to regard a person training to become a member of some occupational group as already being a member of that group. Most errors result from this tendency; but far better that there be errors of this sort than errors of second-guessing the person who recorded the data.

The means on Galton's anthropometric measures (age-corrected), broken down by the above-cited occupational classes (excluding "unemployed") and age (14 to 25 years versus 26 years and older) and separately for males and females, are presented in Tables 10 and 11. One-way analyses of variance on effects of occupational class performed on each measure separately for the 14-to-25 and for the 26 and over age groups generated the F values shown.

For males, as expected, there is a very clear social class effect on the physical measures. Upper class subjects were in general larger than their lower class counterparts, an effect that persisted even for the older subjects, where results probably are confounded by survivorship effects (see above). A somewhat less expected finding is that for males the effect of social class can also be found in the means of the behavioral measures. Upper class males, particularly the younger group, had better eyesight, hearing, reaction time, strength, and breathing capacity than their lower class counterparts. The results for the female subjects are less clear cut, perhaps reflecting the smaller, probably less representative sample used, unreliability in the occupational coding, and/or the restricted occupational opportunities for females in Galton's time.

Upper class male subjects were also found to have matured faster than lower class male subjects on some of the physical measures. Analysis of variance of height by age (14 to 25 years) and occupation (professionals and semiprofessionals combined, "gentlemen," "students," and "unemployed" not included) showed significant effects of age, $F(5, 1078) = 36.10$, $p < .001$, occupation, $F(5, 1078) = 11.76$, $p < .001$, and their interaction, $F(15, 1078) = 1.68$, $p < .05$. As can be seen from the means shown in Table 12, the significant age by occupation interaction results from the later age at which the unskilled class (and to a lesser extent the clerical class) reached their maximum height.

Family Resemblances

Galton kept notes separate from his data set, in which information was entered regarding the biological relationships of his subjects. We have a copy of this set of notes through alphabetical letter *r*. There is no way of verifying spouse resemblances or parent–child resemblances from the data set itself. On the other hand, given this set of notes, sibling resemblances are easily verified, because the data sheet for each of Galton's subjects contains the initials of each parent's first, middle, and last names. We are not highly confident of our family resemblance data except for sibling resemblances, where we have every reason for confidence (both parents have the same initials, subjects have close birth dates, the dates of measurement are the same, etc.); therefore, we present only our sibling resemblance data (all variables age corrected) for siblings whose last names ended in the initials *A* through *R* in Table 13.

So far as we are aware these are the only sibling correlations ever reported for many of these measures. Two generalizations can be made from these data. First, sibling resemblances frequently are substantial in anthropometric, sensory, and reaction-time measures, despite some limitations on reliability. Second, although son–son and daughter–daughter correlations are similar in magnitude (the son–son mean correlation was .36; the daughter–daughter mean correlation was .34), they both are substantially larger than the cross-sex sibling correlations (mean correlation was .18). Ten of the correlations are significantly greater ($p < .05$, z-test) for same-sex versus opposite-sex siblings, whereas only two correlations differ (in different directions) for male versus female sibling pairs. Significance tests and sum of ranks tests also confirm this interpretation of the results. These results suggest that at least some dimensions of anthropometric, sensory, and reaction time measures may be influenced by sex-

[2] We believe that Sebastian Moran serves as a good example of what "unemployed" meant in England close to a century ago. Moran is the protagonist in Arthur Conan Doyle's story "The Adventure of the Empty House" (Doyle, 1903/1975, pp. 449–462).

Table 10
Means for Males' Occupational Differences, by Age, on Galton's Measures

Measures	Professional 14–25 (N = 122)	Professional 26+ (N = 259)	Semiprofessional 14–25 (N = 414)	Semiprofessional 26+ (N = 490)	Merchant, tradesperson 14–25 (N = 58)	Merchant, tradesperson 26+ (N = 103)	Clerical, semiskilled 14–25 (N = 425)	Clerical, semiskilled 26+ (N = 279)
Keenness of eyesight, right (in.)	20.02	19.16	19.95	18.89	19.73	20.14	19.38	18.43
Keenness of eyesight left (in.)	20.28	19.26	20.01	19.37	19.87	20.47	19.59	18.35
Highest audible note (vibrations per sec)	20,304	17,530	20,622	17,500	20,546	17,126	20,118	17,257
Reaction time to sight (sec)	.173	.181	.182	.183	.190	.183	.187	.190
Reaction time to sound (sec)	.146	.149	.154	.153	.152	.152	.155	.157
Breathing capacity (cu. in.)	231.04	221.52	225.02	220.76	218.00	222.14	211.40	214.31
Strength of squeeze (right hand, lbs.)	80.68	81.38	78.03	79.45	79.48	81.61	73.70	78.13
Strength of squeeze (left hand, lbs.)	76.36	76.63	74.53	74.82	73.95	76.44	69.83	74.87
Speed of blow (ft. per sec)	19.81	19.04	19.34	19.34	20.64	18.78	18.42	18.53
Head length (in.)	7.66	7.77	7.62	7.72	7.62	7.75	7.58	7.69
Head breadth (in.)	6.01	6.10	5.96	6.06	5.99	6.10	5.93	6.05
Height (in.)	67.56	67.91	66.83	67.31	65.91	67.79	66.37	66.91
Sitting height (in.)	35.68	35.82	35.42	35.65	35.09	35.90	35.07	35.51
Height to knee (in.)	20.76	20.82	20.30	20.56	20.27	20.83	20.28	20.48
Armspan (in.)	69.94	69.83	68.69	69.29	69.50	69.94	68.46	69.29
Length of middle finger (in.)	4.53	4.56	4.49	4.54	4.53	4.58	4.49	4.58
Length, lower arm (in.)	18.12	18.25	17.92	18.06	17.96	18.18	17.80	18.07
Weight (lbs.)	144.11	157.77	137.92	152.59	140.88	163.88	133.91	153.26
Height/weight ratio	.437	.438	.490	.448	.483	.425	.502	.445

* p .05. ** p .01. *** p .001.

Table 11
Means for Females' Occupational Differences, by Age, on Galton's Measures

Measures	Professional 14–25 (N = 18)	Professional 26+ (N = 25)	Semiprofessional 14–25 (N = 104)	Semiprofessional 26+ (N = 72)	Clerical, semiskilled 14–25 (N = 47)	Clerical, semiskilled 26+ (N = 41)
Keenness of eyesight, right (in.)	20.33	16.45	18.57	19.13	19.74	18.57
Keenness of eyesight left (in.)	20.78	17.12	19.47	18.93	20.30	18.86
Highest audible note (vibrations per sec)	19,444	19,208	21,111	18,859	19,977	18,361
Reaction time to sight (sec)	.164	.199	.192	.192	.193	.207
Reaction time to sound (sec)	.152	.161	.158	.155	.166	.162
Breathing capacity (cu. in.)	139.06	149.08	142.48	137.18	142.60	132.54
Strength of squeeze (right hand, lbs.)	53.06	52.52	51.44	48.40	51.68	48.44
Strength of squeeze (left hand, lbs.)	48.83	50.04	48.86	45.72	49.11	46.27
Speed of blow—(ft. per sec)	—	15.40	14.77	15.25	14.37	14.35
Head length (in.)	7.25	7.30	7.26	7.24	7.27	7.33
Head breadth (in.)	5.79	5.88	5.73	5.75	5.70	5.72
Height (in.)	63.05	63.51	62.88	62.66	63.21	62.49
Sitting height (in.)	33.43	33.98	33.74	33.66	33.80	33.72
Height to knee (in.)	19.31	19.53	19.11	18.71	19.06	19.08
Armspan (in.)	63.57	63.45	63.20	62.52	63.77	62.53
Length of middle finger (in.)	4.19	4.19	4.19	4.14	4.23	4.12
Length, lower arm (in.)	16.41	16.69	16.37	16.20	16.41	16.25
Weight (lbs.)	122.00	134.72	120.91	123.57	123.04	126.56
Height/weight ratio	.523	.485	.526	.515	.522	.498

* p .05. ** $p < .01$.

specific environmental factors and/or by sex-linked genetic influences.

Other large data sets of historical interest exist. For example, Hooton and Dupertuis (1951) reported anthropometric data obtained from 9,955 Irish males in 1935. However, to the best of our knowledge, the original data sheets are unavailable, so that further analyses cannot be conducted. Far larger data sets also exist; for example, Veterans Administration data could provide a tremendous amount of both longitudinal and cross-sectional data, as well as information regarding resemblances of biological relatives on a variety of anthropometric and psychological measures. It is difficult—seemingly impossible—to gain access to these data. The Galton data set is unique not only because the records exist but

Unskilled		Gentleman		Student or scholar		F values	
14–25 (N = 103)	26+ (N = 45)	14–25 (N = 16)	26+ (N = 27)	14–25 (N = 1657)	26+ (N = 139)	14–25	26+
18.37	17.08	22.87	17.44	20.71	19.09	6.13***	1.62
21.37	17.67	21.37	18.76	20.82	19.68	5.37***	1.97
19,903	16,778	21,375	16,375	20,850	18,328	3.94***	1.84
.195	.184	.170	.182	.183	.182	5.59***	1.44
.156	.166	.141	.153	.152	.153	2.65*	2.86**
190.61	209.98	221.37	217.37	217.20	228.06	11.71***	2.04
64.91	75.20	77.81	81.52	74.40	79.95	13.86***	3.03**
62.75	70.76	72.62	76.67	69.87	76.03	13.12***	1.80
18.00	20.43	18.75	20.00	19.34	19.04	6.55***	1.71
7.48	7.62	7.73	7.61	7.60	7.68	5.98***	2.96**
5.82	5.92	5.98	6.11	5.97	6.04	9.83***	4.57***
63.93	66.47	66.09	68.21	66.71	67.11	13.76***	4.92***
33.83	35.24	34.89	36.11	35.02	35.56	13.08***	3.00**
19.93	20.34	20.18	20.81	20.54	20.45	6.09***	2.88**
66.09	68.98	68.38	70.53	68.47	69.19	11.03***	2.32*
4.40	4.59	4.51	4.64	4.47	4.51	3.63**	2.59*
17.55	18.03	17.51	18.22	17.89	17.95	2.45*	1.72
121.33	146.78	134.12	161.11	134.77	146.53	14.69***	8.55
.542	.458	.498	.431	.505	.465	15.11***	6.93***

Unskilled		Lady		Student or scholar		F values	
14–25 (N = 20)	26+ (N = 11)	14–25 (N = 5)	26+ (N = 3)	14–25 (N = 297)	26+ (N = 58)	14–25	26+
19.89	15.50	21.80	23.50	20.24	19.56	1.79	2.63*
20.00	16.40	25.75	22.00	20.53	19.42	1.49	1.40
19,889	16,818	19,800	18,333	20,504	20,018	1.89	2.54*
.190	.206	.174	.213	.188	.191	1.82	1.29
.155	.172	.148	.167	.162	.166	.84	.88
140.55	120.18	148.00	98.33	144.56	141.84	.23	3.40**
51.20	42.55	48.40	43.00	50.69	51.48	.35	2.78**
47.10	42.82	45.60	38.67	47.32	47.33	.60	1.55
14.00	12.50	17.00	—	14.91	15.29	.71	.69
7.22	7.40	7.24	7.30	7.27	7.26	.14	.96
5.74	5.82	5.62	5.87	5.74	5.76	.94	2.81*
62.58	61.90	64.52	64.27	63.05	62.98	.59	1.25
33.17	33.61	34.26	34.83	33.59	33.59	1.13	1.05
19.50	19.20	19.20	19.30	19.21	19.02	.45	2.32*
63.68	62.26	63.24	63.00	63.32	63.09	.34	.73
4.25	4.15	4.24	4.27	4.17	4.19	1.43	1.08
16.95	16.60	16.40	16.70	16.36	16.37	.78	1.52
121.65	130.36	137.00	147.00	120.34	122.93	1.30	2.60*
.518	.481	.480	.445	.531	.521	1.19	3.03*

also because the generosity of Harry Harris of the Galton Laboratory made them available for analysis. Aside from the historical value of the present data, they provide the only information available regarding the test–retest reliabilities of many of these measures, age norms on many of the sensory measures, and sibling correlations on most of the measures.

Ideally, Galton intended that a registry of anthropometric data from large samples of the English population, preferably in families, should be continually maintained. Such a data bank would not only be useful in answering contemporary questions about the nature of individual differences (genetic and environmental influences, family resemblances, social

Table 12
Mean Height by Age and Occupation: Males

Age (years)	Professional & semiprofessional	Merchant, tradesperson	Clerical, semiskilled	Unskilled	Total
14–15	64.54	59.87	61.36	59.99	61.82
N	25	4	24	27	80
16–17	66.31	66.53	65.92	63.62	65.79
N	54	7	80	20	161
18–19	67.39	66.02	66.73	65.90	66.93
N	101	4	107	20	232
20–21	67.02	67.62	66.90	65.94	66.93
N	125	16	105	20	266
22–23	67.13	67.13	66.53	65.59	66.87
N	120	11	65	10	206
24–25	67.34	68.19	67.55	66.65	67.45
N	111	16	44	6	177
Total	67.00	66.91	66.37	63.93	66.47
N	536	58	425	103	1,122

Note. Height was measured in inches.

Table 13
Sibling Correlations on Galton's Measures

Measures	1st son–2nd son (siblings) ($N = 179$)	1st daughter–2nd daughter (siblings) ($N = 105$)	1st son–1st daughter (siblings) ($N = 120$)
Keenness of eyesight			
Right eye	.20**	.24*	.18
Left eye	.19**	.13	.21*
Highest audible tone	.36***	.26*	.22*
Reaction time to sight	.30***	.39***	.45***
Reaction time to sound	.23**	.37***	.19*
Breathing capacity	.40***	.41***	.04
Strength of squeeze (right)	.41***	.35***	−.06
Strength of squeeze (left)	.31***	.22*	−.05
Speed of blow	.28	.27	.04
Head length	.31***	.47***	.19*
Head breadth	.44***	.08	.15
Height	.48***	.35***	.27**
Sitting height	.36***	.42***	.19*
Height of knee[a]	.51***	.47***	.40***
Armspan	.45***	.36***	.25**
Length of middle finger	.46***	.37***	.25**
Length, lower arm[b]	.50***	.42***	.29*
Weight	.35***	.41***	.19*
Height/weight ratio	.23**	.53***	.15

Note. All variables are age corrected.
[a] Height was measured from the sole of foot to knee, while sitting.
[b] Distance from elbow to end of middle finger.
* $p < .05$. ** $p < .01$. *** $p < .001$.

class effects, etc.), but it would also serve as a record of historical changes in the magnitudes and interrelationships of these variables. Such a data bank ultimately did not come to be, and mainstream psychology in this century tended to ignore individual differences as merely "error variance." The analyses we have described using the data that Galton did manage to acquire point out the value inherent in Galton's ideal and suggest that such a continuously maintained data bank and the historical perspectives it would provide may still be of considerable worth in contemporary psychology. The fact that his data—acquired a century ago—are the best and sometimes the only data available regarding some domains of individual differences is indicative of the uneven growth of different areas of psychology.

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