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J. MCKEEN CATTELL
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THE ACCURACY OF OBSERVATION AND OF
RECOLLECTION IN SCHOOL CHILDREN.¹

BY SHEPHERD IVORY FRANZ AND HENRY E. HOUSTON.

Whether accuracy of observation and of recollection differs at different periods of our lives is a problem suggested by Prof. Cattell's paper on this subject.² In order to study this subject, questions similar to those used by Prof. Cattell and by Mr. Bolton, with the changes necessary for time and place and for the age of the scholars, were asked the pupils of the Horace Mann School, New York City, and of the Paterson, N. J., High School.

The following were the questions used: (1) What was the weather a week ago to-day? (2) Two weeks ago? (3) Which way do the seeds in an apple point? (4) How many years ago did George Washington die? (5) How many feet is it from the schoolhouse door to the corner of the street? (6) How many seconds does it take you to walk this distance? (7) How many times have you entered the schoolhouse gate (or door) since vacation? (8) How many ounces does this book (showing a text-book used by the class) weigh? (9) Draw on a scale of one inch to twenty feet, a ground plan of the lower hall.

The accompanying Table³ gives the percentages of correct answers or the average estimation together with the average residual for the two schools.

¹ From the Psychological Laboratory of Columbia University.

² The Accuracy of Recollection, J. McKeen Cattell, *Science*, N. S., II., 761-766, 1895. See also The Accuracy of Recollection and Observation, F. E. Bolton, *PSYCHOL. REV.*, III., 286-295, 1896.

³ Owing to the fewness of answers in some grades it was thought best to combine the several grades of the H. M. S. as follows: I., II., III., IV., V., VI., VII., VIII., High, thus making about forty or fifty answers in each group.

The figures in the Table marked with a cross (†) denote the actual magnitude as used for the Columbia and Wisconsin Students.

As the books used as standards of weight were of different weights, we

TABLE I.

	ACTUAL M'GN'T'DE.	H.M.S. I.II.III.	H.M.S. IV.V.VI.	H.M.S. VII.VIII.	H.M.S. HIGH.	H.M.S. TOTAL.	P.H.S. I II.III.	COLUM- BIA.	WISCON- SIN.
Age.		7-9.	10-12	13-14	14-17	7-17	14-17	—	—
No. of Answers.		56	63	48	34	201	325	56	92
Weather, 1 wk. previous.	H. M. S. clear. P. H. S. cloudy.	40%	81%	95%	85%	78%	4%	11% stormy clear- ing.	32% (?) stormy.
Weather, 2 wks. previous.	H. M. S. clear. P. H. S. stormy.	34%	49%	65%	65%	53%	29%	—	—
Direction of Apple Seeds.	H. M. S. P. H. S. =	51%	52%	26%	51%	45%	49%	41%	49%
Yrs. Av. Est. since W's death. Av. Res.	H. M. S. P. H. S. 96.	97 54	87 33	97 12	99 8	95 26	102 13	— —	— —
Av. Est. Distance in feet. Av. Res.	H. M. S. 400 P. H. S. 260	160	183	167	226	181	197	356 179 [310]	276 — [450]
Av. Est. Time in seconds. Av. Res.	H. M. S. 80 P. H. S. 55	65	82	97	97	84	70	66 36 [35]	182 — [160]
Av. Est. Frequency. Av. Res.	H. M. S. 100* P. H. S. 180	179	252	122	152	183	452	4022 2669 [?]	— —
Av. Est. Weight in Ounces. Av. Res.	H. M. S. 10 P. H. S. 14	7.8	7.6	6.5	6.0	7.1	12	17 5 [24]	20.5 — [24]
Av. Est. Proportion, Width, Length. Av. Res.	H. M. S. 10.2 P. H. S. 1.74	—	8.7	7.8	8.5	8.3	1.14	—	1.7 — [2.0]
Av. Est. Length in mm. Av. Res.	H. M. S. 211. P. H. S. 118	—	116	145	158	141	105	—	6. — [9.6 in]
Av. Est. Width in mm. Av. Res.	H. M. S. 13. P. H. S. 16	—	15	21	23	19	87	—	3.5 in. — [4.7 in]

Taking the figures more in detail, it will first be noted that the H. M. S. has a much larger percentage of correct answers to the two weather questions than any of the other schools. This is no doubt due to the fact that the weather on the two days about which the pupils were asked was 'clear,' and as we have more clear days than other kinds we should expect an increase according to the probability. Not knowing the probability of this and the other kinds of weather, we cannot compare the other schools, but considering the H. M. S, alone it seems likely that accuracy of recollection increased with age.

In the next question, however, this is not the case, for the younger scholars in the H. M. S. had the same percentage correct as the older, and a trifle greater percentage than the College students. Some chance variation caused a decrease to 5 per cent. in the seventh grade, whence the total for that group (VII., VIII.) was reduced to 26 per cent.

In the quantitative estimations it will be noticed that, like the College students, the younger children underestimate weight and size (proportion) and overestimate time. They also overestimate frequency and with the Wisconsin students underestimate distance and size (length of building). The H. M. S. and the P. H. S. overestimated the breadth of the hall or building, while the Wisconsin students underestimated the corresponding magnitude. In these estimations, however, there seems to be no regular increase or decrease in accuracy, except in the cases of 'weight,' 'length,' 'width,' and 'time.' Taken as a whole, however, the older scholars are more accurate than the younger. This is shown, also by the average residuals, which for the

have here reduced the estimations, taking ten ounces as a standard. The validity of this procedure is somewhat doubtful, but it was necessary in order to make any comparison of the grades. We, however, give here the actual magnitudes, the average estimations, and the residuals for the several grades.

TABLE IA.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	High.
Magnitude.	—	12.5	10.5	10.5	13.5	10.5	14.	19.5	18. I. II.
Av. Est.	—	12.5	6.	8.7	8.7	7.8	10.	11.	10.4
Av. Res.	—	5.	4.5	5.4	5.	3.7	4.	3.4	3.7 3.6

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older scholars are considerably smaller than for the younger. The questions are so complex in themselves, all including observation, with errors of judgment, and memory with its errors, that no general conclusion can be drawn.

Accuracy according to Sex. From the following Table showing the percentage of right answers and the average esti-

TABLE II.

	H. M. S.		P. H. S.		WISCONSIN.	
	BOYS.	GIRLS.	BOYS.	GIRLS.	BOYS.	GIRLS.
Weather, 1st wk	74%	81%			19%	54%
Weather, 2d wk	49%	57%			—	—
Apple seed	48	43			50% [only part]	46%
Yrs. since W.'s death . . .	95 (96)	91	89. (96)	102.	—	—
Distance	231 (400)	151	189 (260)	196	296 (450)	261
Time.	72 (80)	90	46. (55)	67.	177 (160)	187
Frequency.	191 (100*)	178	505 (180)	468	—	—
Weight	7.8 (10)	6.7	11. (14)	12.	22.8 (24)	19.8
Proportion	9.7 (10.2)	7.0	1.26 (1.74)	1.08	—	—

N. B.—The actual magnitudes are shown in parentheses.

mations for the H. M. S., the P. H. S. and the Wisconsin students. One sees that the girls remember the weather better than the boys, but that the estimations of the boys for distance, time and proportion are nearer the standard. The boys in the H. M. S. came nearer to the date of Washington's death, while the boys and girls of the P. H. S. were about equally correct. With weight the H. M. S. boys again came nearer, while the girls of the P. H. S. were more exact. With frequency the girls in both cases were more correct. The general

conclusion to be drawn is that in quantitative measurements the boys are more exact. This is also what Mr. Bolton found with the Wisconsin students.

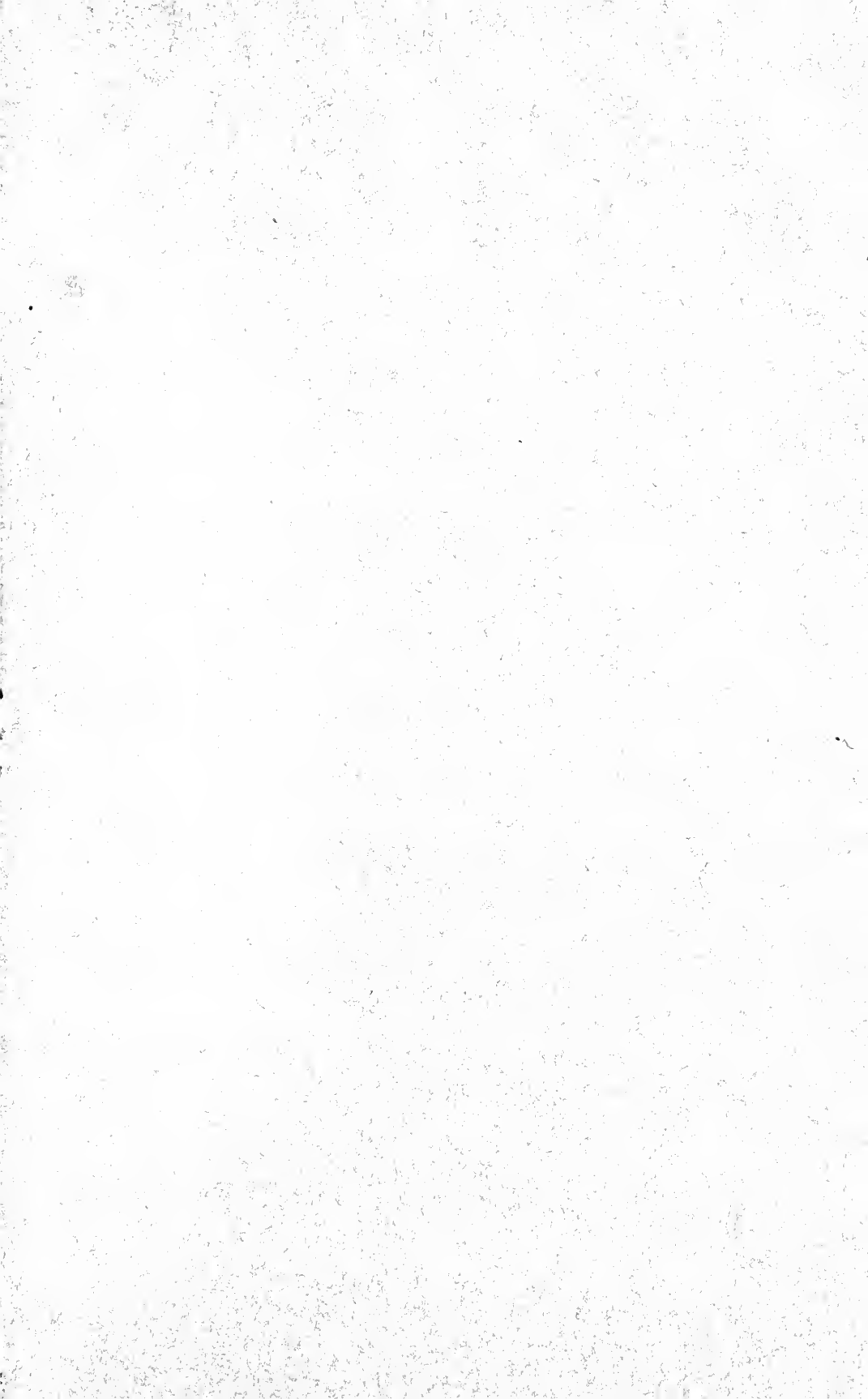
Relation of Confidence to Accuracy. When the students were asked the questions they were told to denote by the letters A, B, C or D, respectively, whether they were sure their answers were correct, fairly confident, doubtful, or if their answers were only a guess. The following table gives the average estimation when the students were confident (A and B), and when they were doubtful (C and D).

TABLE III.

	YRS. SINCE W'S DEATH.	WEIGHT IN OZ.	DISTANCE IN FT.	OCCUR- RENCE.	TIME IN SECONDS.
A. and B. H. M. S.	88.5		152	205	91
C. and D.	138. (96)	(10)	285 (400)	213 (100)	101 (75)
A. and B. P. H. S.	100	12	203	386	
C. and D.	104 (96)	11.5 (14)	214 (160)	475 (180)	(55)

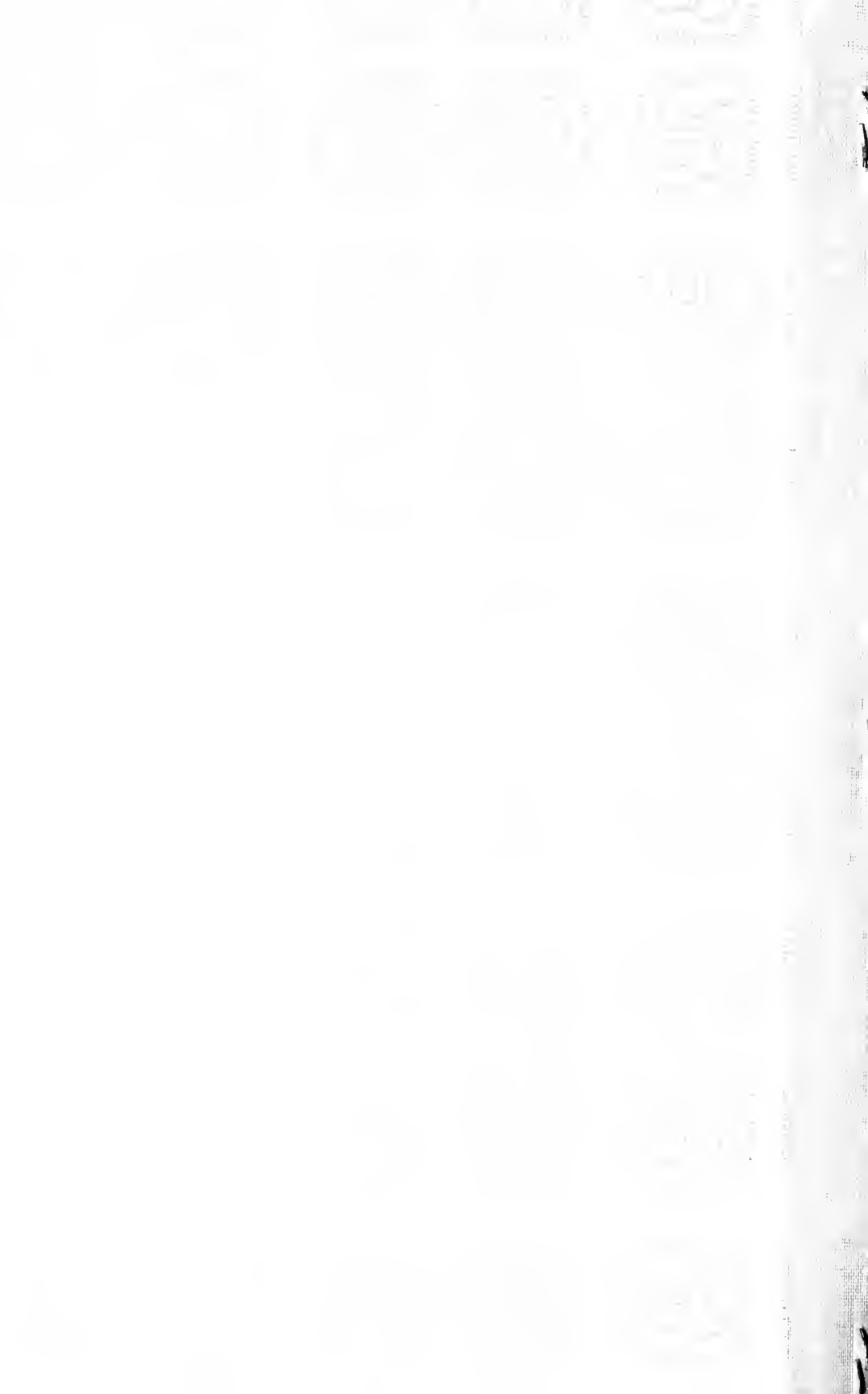
Here, too, the evidence is conflicting and no general conclusion can be drawn. In the estimation for years since W's death, and for number of occurrences the more confident answers are nearer the truth. When we look at the estimation for distance, however, we see that the two schools disagree. The small difference, too, between the estimates in some cases (*e. g.*, years P. H. S., distance P. H. S., occurrence H. M. S.) together with a large variation (in most cases one-third of the average estimation) makes it unwise to hazard any conclusion.

It was found that scholarships did not at all influence the results. Those classed as the best students estimated as wildly as those considered the worst; those considered as of medium ability were a little more accurate than the two extremes.



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