

# THE PSYCHOLOGICAL BULLETIN

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## A NOTE ON MEASUREMENT BY RELATIVE POSITION

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A few difficulties are generally encountered in the use of Thorndike's method of measurement by relative position.<sup>1</sup> The more important ones are:

- (a) Total agreement between judges is given a value of  $\infty$ .
- (b) One is advised to interpret the value of  $\infty$  as 2 P.E., later on.
- (c) The  $\Delta$  table is given for divisions of opinions between two to fourteen judges. A table giving P.E. differences up to twenty judges would be a considerable aid.
- (d) Inspectional arrangement of judgments may yield an unreliable lineation of the subjects judged.

The following suggestions may assist the elimination of these difficulties:

(a) "Total Agreement" for judges *under* 100 may be considered equal to 4.6 P.E. And "Total Agreement" for judges *over* 100 may be taken equal to 6 P.E.

(b) In the table which is herewith presented "Total Agreement" is given a value of 4.6 P.E., a figure more in harmony than 2 P.E. with the progress of the judgment-differences.

(c) This table also extends Thorndike's original list to include judgments of from fifteen to twenty judges.

(d) It is advised that instead of arranging a series of judgments by inspection, the arithmetic mean be utilized for this purpose.

*Reasons for the Changes.*—(a) and (b) Theoretically, if the total

<sup>1</sup> E. L. THORNDIKE, "Technique of Combining Incomplete Judgments of the Relative Positions of  $N$  Facts, Made by  $N$  Judges." *J. of Philos., Psychol. & Sci. Meth.*, 1916, 13; 197-204.

number of judges agree, placing one fact measured above another, that particular fact is at an *infinite* distance above the other. For practical purposes this limit is given an arbitrary numerical value, which can be made reasonable even though arbitrary. Thorndike originally assigned to  $\infty$  the value 2 P.E. Reference to the original  $\Delta$  Table will make the incongruity of this value evident. Thus in the case of 14 judges a division of 12 to 2 equals 1.58 P.E.; 13 to 1, 2.17 P.E.; and 14 to 0,  $\infty$  or 2 P.E.! If anything, it should be more than 2.17 P.E. This point is still more striking when dealing with 20 judges. A division of 18 to 2 equals 1.90 P.E.; 19 to 1, 2.44 P.E.; and 20 to 0, 2 P.E.!

Now to reply to the possible query, why 4.6 P.E. has been chosen as the more reasonable value to substitute for  $\infty$ . If we had 100 judges, a division of opinion 100 to 0 equals a difference between adjacent facts or items equal to  $\frac{50}{100}$  or 0.500, which equals  $\infty$ . (See P.E. Table.) A division of 99 to 1 equals a difference between facts of  $\frac{49}{100}$  or 0.4900, which equals 3.45 P.E. Evidently the 100 to 0 division should be greater than 3.45 P.E. How much greater can be determined empirically by plotting the P.E. values for each division of opinion from 50-50 to 99-1, and continuing the curve onward to 100-0.

Again, if we had 1,000 judges, a division of 999 to 1 equals a difference between facts of  $\frac{499}{1000}$  or 0.499 which equals 4.62 P.E. Consequently a division of opinion of 1,000 to 0 should be greater than 4.62 P.E.

Since 100-0 should be greater than 3.45 P.E., and since 1,000-0 should be greater than 4.62 P.E., it seems reasonable to place the 100-0 division of opinion equal to 4.6 P.E. It is deemed advisable not to change, as yet, the value of  $\infty$  from 4.6 P.E. for any number of judges below 100. In fact it is highly probable that most of the studies which will utilize this method will not exceed judgment of over 100 judges. Should tables be devised for judges above 100 it would seem more logical to interpret  $\infty$  equal to 6 P.E.,<sup>2</sup> which, for practical purposes, is understood to include half the range of a normal probability surface, with the median as the dividing line.

<sup>2</sup> Further mathematical study is necessary to determine whether the P.E. values for "Total Agreement" should increase as the number of judges increases. There are as many off-hand reasons for arguing progression as for non-progression. More careful analysis of this matter is necessary.

It is an open question whether in educational or psychological data  $\infty$  should ever be interpreted greater than 6 P.E.

(d) Since the final assignment of P.E. values to the various items or individuals judged is dependent upon how accurately the preliminary seriation of the items or the individuals is made, it is essential that this preliminary arrangement of judgments be made as accurately as possible. It is evident that arrangement by inspection is too largely affected by accidental factors and individual idiosyncrasies. This variation in initial arrangement might, with exactly the same raw data, yield different final results in the case of two random inspectors. But this factor of variation in arrangement can be eliminated if the arithmetic mean of the judgments for each fact or individual is found, and the preliminary seriation made dependent on these mathematical results. The arithmetic mean is selected in preference to any other average for the reason that equal weight is given to the opinion of each expert or judge. To the problems which this method has found application here, this procedure of determining the original lineation of items, followed logically our preliminary modification of the Thorndike procedure by directing the judges to assign to the items judged, values between 1 per cent. to 100 per cent. according to the position of a given item in a group with reference to *all* the others in this group.

*Applications of the Method.*—Mr. F. E. Barr and Mr. E. J. Buckles have been kind enough to permit me to utilize here a portion of their final data in their application of this method to the devising of an occupational scale which they promise for early publication.

Hobo. ....	0 P.E.
Track Layer.....	4 P.E.
Metal Finisher.. ....	8 P.E.
Librarian.....	12 P.E.
Artist.....	16 P.E.
Inventive Genius.....	20 P.E.

It does not require a great deal of psychological or statistical insight to appreciate the general value of such a scale to that suggested by Taussig or Saffioti.

The writer is indebted to Mr. J. F. Abel and Mr. K. M. Cowdery, graduate students in advanced educational statistics, whose wrestling with the problem has led him to this refinement in technique.

## Δ TABLE

THE DIFFERENCES IN TERMS OF P.E. CORRESPONDING TO ANY DIVISION OF OPINIONS  
AMONG 2, 3, 4, 5, . . . 20 JUDGES

<i>N</i>	<i>D</i>	Δ	<i>N</i>	<i>D</i>	Δ	<i>N</i>	<i>D</i>	Δ	<i>N</i>	<i>D</i>	Δ
2	1-1	0.00	10	5-5	0.00	14	7-7	0.00	18	9-9	0.00
2	2-0	4.60	10	6-4	0.38	14	8-6	0.27	18	10-8	0.21
			10	7-3	0.78	14	9-5	0.54	18	11-7	0.42
3	2-1	0.64	10	8-2	1.25	14	10-4	0.84	18	12-6	0.64
3	3-0	4.60	10	9-1	1.90	14	11-3	1.17	18	13-5	0.87
			10	10-0	4.60	14	12-2	1.58	18	14-4	1.13
4	2-2	0.00				14	13-1	2.17	18	15-3	1.43
4	3-1	1.00	11	6-5	0.17	14	14-0	4.60	18	16-2	1.81
4	4-0	4.60	11	7-4	0.52				18	17-1	2.36
			11	8-3	0.90	15	8-7	0.12	18	18-0	4.60
5	3-2	0.38	11	9-2	1.35	15	9-6	0.38			
5	4-1	1.25	11	10-1	1.98	15	10-5	0.64	19	10-9	0.10
5	5-0	4.60	11	11-0	4.60	15	11-4	0.92	19	11-8	0.30
						15	12-3	1.25	19	12-7	0.50
6	3-3	0.00	12	6-6	0.00	15	13-2	1.65	19	13-6	0.71
6	4-2	0.64	12	7-5	0.31	15	14-1	2.23	19	14-5	0.94
6	5-1	1.43	12	8-4	0.64	15	15-0	4.60	19	15-4	1.19
6	6-0	4.60	12	9-3	1.00				19	16-3	1.49
			12	10-2	1.43	16	8-8	0.00	19	17-2	1.86
7	4-3	0.27	12	11-1	2.05	16	9-7	0.23	19	18-1	2.40
7	5-2	0.84	12	12-0	4.60	16	10-6	0.47	19	19-0	4.60
7	6-1	1.58				16	11-5	0.72			
7	7-0	4.60	13	7-6	0.14	16	12-4	1.00	20	10-10	0.00
			13	8-5	0.44	16	13-3	1.32	20	11-9	0.19
8	4-4	0.00	13	9-4	0.74	16	14-2	1.71	20	12-8	0.38
8	5-3	0.47	13	10-3	1.09	16	15-1	2.27	20	13-7	0.57
8	6-2	1.00	13	11-2	1.51	16	16-0	4.60	20	14-6	0.78
8	7-1	1.71	13	12-1	2.11				20	15-5	1.00
8	8-0	4.60	13	13-0	4.60	17	9-8	0.11	20	16-4	1.25
						17	10-7	0.33	20	17-3	1.54
9	5-4	0.21				17	11-6	0.56	20	18-2	1.90
9	6-3	0.64				17	12-5	0.80	20	19-1	2.44
9	7-2	1.13				17	13-4	1.07	20	20-0	4.60
9	8-1	1.81				17	14-3	1.38			
9	9-0	4.60				17	15-2	1.76			
						17	16-1	2.32			
						17	17-0	4.60			

*N* = No. of judges. *D* = Nature of division among the judges. Δ = Corresponding differences in terms of P.E.