A STANDARDIZATION AND WEIGHTING OF TWO HUNDRED ANALOGIES

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Of all the various forms of controlled association tests the mixed relations or analogies test is known to be one of the most useful and reliable. It differs from certain other association tests in that the form of the response is restricted. This restriction varies from one stimulus to another within the series of terms, and its nature is not revealed to the subject in the instructions but is supplied by the material and must be perceived by him from the material (6). Its widespread use in some form or other, has seemed to justify a somewhat more extensive weighting and standardization than has been attempted up to this time.

The form of the analogy seems to have had its origin with the Aristotelians, and it has come down to us through logic and formal grammar. Among the earliest attempts to use the analogous relation, its perception and completion, as a mental test was that of Woodworth and Wells (1). Similarly it was used by Whitley (2) in her study of the validity of various forms of association tests in respect to practice effect, variability and intercorrelation; by Burt (3) who gave the name analogies to the test; by Briggs (4) in his study of the disciplinary effects of instruction in grammar on the higher mental processes of school children; by Wyatt (5) in comparing abilities of Manchester children of various ages; by Bingham and Whipple (6) with American college students. More recently the test has been employed by Whipple, Henry, Manuel and Coy (7) for the selection of gifted children, by Rogers (8) in her tests for the diagnosis and prognosis of mathematical abilities, in the Otis Absolute point scale (9) and the Otis Group Intelligence test; in the Army Alpha tests; by Thurstone in his tests for college Freshmen and High School Seniors; by Yerkes, Bridges and Hardwick (14) in their Point Scale; by Thorndike (the pictorial and geometric form of the test) in his Non Verbal Intelligence Scale (15); by

the Bureau of Salesmanship Research, and in many "omnibus" test groups.

Woodworth and Wells (1) claim the test measures "skill in handling associations," "flexibility of mental performance;" Burt (3) "perceptions, implicit or explicit, of the relation and reconstruction of the analogous one by relative suggestion;" Briggs (4) "rapidity and accuracy of mental reorientation," the "functioning of meaning tendencies" Whipple (7) is "confident that the analogies test brings out an ability that is decidedly symptomatic for the purpose of selecting gifted children." Wyatt (5) and Bickersteth (10) speak of it as a test of discrete reasoning

Until the comparatively recent development of group testing, the lists of Woodworth and Wells, and of Whipple and Fraser, comprising some 20 single analogies to each list, were most commonly used, and this most frequently as an individual test wherein the association reaction time played a very important part.

There are two possible ways of scoring analogies:

1. To give credit according to the time required to find the analogy;
2. To give credit according to the difficulty of the analogy as determined by a standardization based upon the percentage of passes or failures.

Green (11) found such a high correlation ($r=.87$) between time as a measure of difficulty and the percentage of passes and failures, that it would seem best to follow the second of these methods. In general the scheme of weighting outlined by Rugg (12 and 13) was the one adopted in this study.

In making up our list of analogies we made selections from every available existing list, picking out the best ones and avoiding duplications as far as possible. A few original ones were added. After trying out in a preliminary way a large number, we finally selected two hundred and had them printed on a four-page folder, with fifty on each page. Ten point type was used for the first three terms, followed by four or five "choice" words, printed in bold-face type of the same size. A specimen of the original list is shown below:

- 51 better—good :: worse—**very-good medium bad much-worse best**
 52 grass—cattle :: bread—**butter flour milk man horses**
 53 large—object :: loud—**soft small heavy weight sound**
 54 king—kingdom :: president—**vice-president senate republic**
 queen democrat

- 55 Man—revolver :: bee—**wings** honey flying wax sting
 56 egg—bird : plant—**seed** shell leaf root feathers
 57 ignorance—education . poverty—**laziness** school **wealth** charity
 teacher
 58 circle—square :: sphere—**circumference** cube round corners ball
 59 point—line :: line—**surface** pencil dot curve solid
 60 disease—sanitation :: accident—**doctor** hospital bandage **cleanli-**
 ness care
 61 ordinary—exceptional many—all none few common more

The subject is required only to underscore one of the choice words in black type to complete each analogy. Otis (9) has called attention to the fact that the chance-success factor in this procedure is more than atoned for by its ease of administration and scoring. Retrial with some of our subjects substantiates this view. No attempt was made in the limits of this study to deal with the pictorial or geometric forms of the test, devised and used by Thorndike (15) and by the National Research Council tests. Neither did we attempt, except in a superficial way, to try the construction of new and original analogies as a test. These are problems by themselves which would require special study and research.

The instructions to the subjects, after the usual preliminaries and samples, were in part: "You are to discover in what way some word among those in black type has the same relation to the third word in the series as the first and second have to each other. Then draw a line under that word. If you do not see the relation in about 8 seconds or are in doubt about it, mark the word that seems nearest it and go on to the next." Sufficient time was permitted for the subjects to mark each of the two hundred. The work limit method was employed with the first 100 subjects. The mean time for this group turned out to be about 26.5 minutes for the list. About 7 seconds is ample time to allow for each analogy in building a scale of the tests. It was found that if the subject was unable to perceive the relationship in about 4 or 5 seconds the chances were extremely great that never would he be able to do so correctly at that sitting. One group of 50 second-year College students were asked after completing the list to go back over it and carefully check the ones in their judgment regarded to be certainly right, wrong or doubtful. After scoring the papers it developed that the subject's opinion regarding the correctness or incorrectness of his responses has about a one-to-one chance of being right or wrong and so must be considered as uniformly unreliable.

The subjects numbered 917 in all. Of these there were 47 graduate students, 100 University Seniors and Juniors, 590 Normal College first and second-year students, and 180 High School students in grades XI and XII. The chronological ages ranged from 16 to 38 years. To determine whether we had a fairly random sampling of intelligence in our subjects we took a group of 52 second-year Normal College students and tested them with the Otis scale, form A. The scores ranged from 87 to 198, with the median at 158, Q_3 at 172, Q_1 at 151, $Q = 10.5$ and $\sigma = 6.7$. A product moment coefficient of correlation, uncorrected for attenuation, between the Otis and analogies scores for these subjects showed $r = .785 \pm .035$.

The ability measured by the analogies test shows rather steady and progressive increase with age. Our results shown in Table I conform fairly well to those of Bickersteth (10).

TABLE I

Group	Number	Mean Errors Of 200	Range
Graduate Students	47	21 8	5-59
Normal College Second Year	120	30 5	6-58
Normal College First Year	82	36 3	8-142
High School Seniors	97	35.0	11-153
*VIII. Grade	31	80 0	23-200

*Not included in our group of subjects.

Wyatt (5) found the test to correlate highly (.80) with intelligence. The reliability of the test as shown by him for 409 Oxford girls was:

Age	r
10	.35 $\pm$.09
11	.62 $\pm$.06
12	.78 $\pm$.04
13	.76 $\pm$.05

Bickersteth (10) adds "there does not seem to be much difference as the result of practice in the test once its nature is grasped by the subject—the marks gained in series 2 and 3 were often identical."

Burt (3) concludes that "those tests involving higher mental processes such as Reasoning, vary most closely with intelligence, and are least vitiated by various irrelevant conditions such as sex, social status, training of the experimenter, and mass measurements of numbers of subjects at once."

The weights of each analogy were determined by ascertaining the total number of the 917 subjects who failed each analogy. This number was then converted into a per cent of the total, by dividing by the number of subjects. Assuming a normal distribution of the trait measured in a curve whose limits are included in a range of $\pm 3\sigma$, setting 0 at -3σ , 50 at the mean and 100 at $+3\sigma$, the percentages of failures were transmuted into equivalent values of sigma. By the use of Rugg's table (12, appendix, Table VI) each was likewise assigned a percentile value.

In addition, each analogy was assigned a point value. This point value is purely arbitrary, and calculated in order to arrive at groups of analogies which are roughly of equal difficulty. The sum of all the percentile values of the 200 analogies is 6,002. Dividing this by 1,000, we get a constant 6 by which all the percentiles have been divided, thus turning the percentile values into relative point values. The sum of all the point values of the 200 analogies is 1,000.

In this way we have three possible methods of weighting or scoring each analogy. The sigma values give the finest differentiations and lend themselves to as fine a system of scoring as may be desired. The percentiles give a somewhat rougher method, and the point values still more so. Using either of these three methods we may easily construct different lists of analogies of equal difficulty.

We print here the list of 200 analogies arranged according to difficulty, giving the percentile, sigma and point values. The correct response is italicized.

POINT VALUE

Percentile	Sigma		100
62 ..	3.76	heat—a gas	cold—ice winter <i>water</i> refrigerator
61 ..	3.68	truth—falsehood	:: pride—fear shame honor <i>humility</i>
60 ...	3.64	toil—soil	: pay—check <i>gay</i> debt money
	3.64	darkness—sunlight	: stillness—quiet <i>sound</i> loud dark moonlight
			9.5
58 ...	3.53	point—line	:: line— <i>surface</i> pencil dot curve solid
	3.49	oil—toil	:: hate—love work boil <i>ate</i> hat
57 ...	3.47	motion—physics	:: blood—temperature body veins <i>physiology</i> geography

9.0

- 55....3.34 sorrow—misfortune :: joy—grief happiness hatred *success*
 pride
 3.32 anger—violence :: love—*caressing* hate temper hope happi-
 ness
 3.31 circle—ellipse :: square—cube curve oval circle *diamond*
 3.31 land—wealth :: sun—*life* earth death moon
 3.31 evolution—revolution :: crawl—baby floor stand *run* hands
 and knees

8.5

- 52....3.17 fear—anticipation :: regret—*memory* hope sorrow hate
 forget
 51....3.11 book—knowledge :: money—paper dollars *bank* work gold
 50... 3.00 Sunday—week :: January—*year* hour Wednesday month

8.0

- 49....2.99 moon—earth :: earth—Mars *Sun* clouds stars universe
 2.97 land—peninsula :: ocean—river lake cape *gulf* water
 2.97 known—unknown :: present—past expensive *future* Christ-
 mas

7.5

- 47....2.87 tolerate—pain :: welcome—*pleasure* unwelcome friends
 give
 2.86 better—good :: worse—very-good medium *bad* much-worse
 best
 2.84 disease—sanitation :: accident—doctor hospital bandage
 cleanliness *care*
 46....2.77 electricity—wire :: gas—flame spark hot *pipe* stove
 2.76 engineer—chauffeur :: locomotive—iron stack engine *auto*
 2.76 character—important :: complexion—blonde *trivial* bru-
 nette good
 2.76 behind—late :: before—after soon *early* dinner
 45....2.70 advice—command :: persuasion—help aid urging *compul-*
sion

7.0

- 43....2.62 man—skull :: church—umbrella rain Sunday *dome*
 2.61 ice—water . water—land *steam* cold river thirst
 2.61 arteries—body :: railroads—*country* train crossing accident
 2.60 beautiful—appearance :: sweet—*taste* beauty sour ugly nice
 2.60 uncle—aunt . son—brother *daughter* sister father girl
 42....2.57 city—mayor . army—soldier navy private *general*
 2.57 officer—private :: command—army general *obey* regiment
 2.52 camp—safe :: battle—win field fight *dangerous*

6.5

- 41....2.48 wood—table :: knife—cutting chair fork *steel* handle
 2.46 rudder—ship : tail—*bird* sail dog cat
 40.. 2.44 quarrel—enemy :: agree—policeman agreeable foe *friend*
 2.40 ordinary—exceptional :: many—all none *few* common more
 2.40 large—elephant :: loud—soft hear *cannon* see
 2.40 lion—animal : rose—small bird *plant* thorn
 39....2.38 city—telephone-system : body—arteries *nerves* arms
 clothes skeleton

6.0

- 38... 2.33 ignorance—education :: poverty—laziness school *wealth*
 charity teacher
 2.30 circle—square :: sphere—circumference *cube* round corners
 ball
 2.29 imitate—copy : invent—study invention machine *originate*
 37... 2.27 sand—glass :: clay—stone hay *bricks* dirt
 2.25 liquid—solid :: water—salt steam lake *ice*
 2.25 succeed—fail :: praise—lose friend God *blame*
 36... 2.19 large—object :: loud—soft small heavy weight *sound*
 2.17 wolf—sheep :: cat—fur kitten dog *mouse*
 2.16 rafters—house :: skeleton—bones skull grace *body*

5.5

- 35 . 2.15 cold—ice :: heat—wet cold *steam* stars
 2.15 success—joy :: failure—*sadness* success fail work
 2.15 past—present :: yesterday—*today* tomorrow Christmas
 gone
 2.15 writer—books :: bee—hive *honey* wasp sting
 2.15 mountain—valley :: genius—*idiot* right think brain
 2.13 tiger—carnivorous : horse—cow pony *herbivorous* buggy
 2.13 tears—laughter :: sorrow—*joy* distress funeral sad
 2.12 part—whole : Indiana—state Ohio Indianapolis *United*
States
 2.11 hope—despair happiness—frolic fun joy *sadness*
 2.11 cold—heat :: ice—cream frost refrigerator *steam*
 34... 2.09 Sunday—Friday : Monday—Tuesday *Saturday* week
 Thursday
 2.09 eraser—ink :: water—lightning storm *dirt* clothes
 2.07 dismal—dark :: cheerful—fun *bright* house gloomy
 2.06 grass—cattle : bread—butter flour milk *man* horses
 2.06 egg—bird :: plant—*seed* shell leaf root feathers
 2.05 breeze—cyclone :: shower—bath *flood* winter spring
 2.04 lion—animal :: rose—smell leaf *plant* thorn
 33 . 2.02 Japanese—Japan : Dutch—Russia *Holland* Siberia Spanish
 prosperity—happiness..adversity—success *sorrow* fun rage
 2.00 arm—elbow :: leg—foot *knee* stocking toe heel
 2.00 hunter—gun :: fisherman—fish bold wet *net*
 1.98 music—noise :: harmony—hear accord violin *discord*

5.0

- 32 ... 1.96 king—kingdom :: president—vice-president *republic* queen
 democrat
 1.96 bird—song : man—woman *speech* boy work
 1.96 peace—happiness :: war—*sorrow* fright battle Europe
 1.93 horse—mule :: obedient—disgraceful *stubborn* donkey obey
 31... 1.88 electric light—candle :: automobile—*carriage* electricity tire
 speed glow
 1.88 truth—gentlemen : lie—*rascal* live give falsehood
 1.87 ruler—length : clock—hour distance *time* alarm
 1.86 head—hat :: hand—arm *glove* finger wrist
 1.86 man—boy :: sheep—wool *lamb* goat shepherd dog
 1.86 peninsula—continent :: bay—Massachusetts boats *pay*
ocean

- 30 ... 1.85 pretty—ugly :: attract—fine *repel* nice draw
 1.84 pupil—teacher :: child—*parent* doll youngster obey
 1.84 hospital—patient :: prison—cell *criminal* bar jail
 1.82 wash—face :: sweep—broom *floor* straw clean
 1.82 book—writer :: statue—liberty *sculptor* picture state
 1.82 captain—ship :: mayor—state council *city* ship boss

4.5

- 29... 1.77 eat—fat :: starve—food *thin* bread thirsty
 1.76 Monday—Tuesday :: Friday—week Thursday day *Saturday*
 1.76 man—revolver . bee—wings honey flying wax *sting*
 1.76 pan—tin . table—chair *wood* legs dishes
 1.75 body—food . engine—wheels *fuel* motion smoke fire
 1.75 tears—sorrow . laughter—girls grin *joy* sob
 1.74 lead—bullet :: gold—paper *coin* silver copper
 28... 1.71 picture—see . sound—noise music bark *hear*
 1.71 lobby—hotel . preface—author *book* porter elevator
 1.70 water—fish . air—spark *man* blame breathe
 1.70 man—arm : tree—shrub *limb* flower bark
 1.69 spoon—soup . fork—knife plate *meat* cup
 1.68 floor—ceiling . ground—earth hill grass *sky*
 27 .. 1.67 Edison—phonograph . Columbus—Spain *America* Wash-
 ington Ohio
 1.66 poison—death : food—eat bird *life* bad
 1.66 singer—song :: preacher—choir organist pulpit *sermon*
 1.65 abundant—cheap :: scarce—buy bargain *costly* nasty
 1.64 floorwalker—store . policeman—fire *street* conductor
 wagon
 1.64 peeling—banana : shell—skin orange *egg* juice ripe
 1.64 foot—man : hoof—leather shoe *cow* leg
 1.63 cannon—large . rifle—ball *small* bore shot
 1.63 historian—facts . novelist—*fiction* Dickens writer *book*
 1.63 bold—timid : advance—proceed *retreat* campaign soldier
 1.63 ear—hear eye—hair blue *see* eyebrow

4.0

- 26 1.60 razor—sharp . hoe—bury *dull* cuts free
 1.60 light—dark :: noise—report ring *silence* sound
 1.59 book—author :: statue—*sculptor* marble model magazine
 man
 1.59 establish—abolish . begin—work year *end* commence
 1.59 ocean—pond . deep—sea well *shallow* steep
 1.58 flag—country . cross—purgatory *christianity* army presi-
 dent
 1.58 December—January :: last—*first* least worst month
 1.57 boy—man :: lamb—wool dog *sheep* shepherd
 1.57 order—confusion :: peace—part treaty *war* enemy
 1.57 hat—head . thumb—*finger* needle thread hand sewing
 25 1.55 reward—hero punish—God everlasting pain *traitor*
 1.55 hand—arm . foot—*leg* toe finger wrist elbow
 1.53 Yes sir—No sir :: always—meanwhile however perhaps
never
 1.53 confusion—order : war—guns *peace* powder thunder army
 1.52 engine—caboose . beginning—commence cabin *end* train

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- 1 52 10—100 : 1000—money *10,000* 20,000 wealth
- 1 52 knitting—girls :: carpentry—trade houses *boys* lumber
- 1 52 add—subtract :: multiply—add *divide* arithmetic increase
- 1 52 automobile—wagon :: motorcycle—ride speed *bicycle* car
- 1 51 foot—man : hoof—leg dog *horse* boy shoe
- 1 51 complex—simple : hard—brittle money *easy* work
- 1 51 frame—picture : lake—porch photo window *island*
- 24 ... 1 48 sweet—sugar : sour—sweet bread man *vinegar*
- 1 47 a—b : c—e *d* b letter
- 1 46 left—right : west—south direction *east* north
- 1 46 granary—wheat : library—desk *books* paper librarian
- 1 46 dog—bark : cat—fur chase *mew* mouse
- 1 44 palace—king : hut—*peasant* barn farm city

3 5

- 23 ... 1 43 man—woman : brother—daughter *sister* boy mother son
- 1 43 door—house : gate—chimney yard swing window
- 1 41 hope—happiness : despair—grave repair death *grief*
- 1 41 sit—chair sleep—*bed* rest wake snore
- 1 38 winter—summer : cold—freeze *warm* wet January
- 22 ... 1 37 blonde—brunette : light—heavy electricity *dark* girl
- 1 35 esteem—friends :: despise—*enemies* forsake detest people
- 1 35 Yes—No affirmative—win debate deny *negative*
- 1 35 cellar—attic : bottom—well tub *top* house
- 1 35 birth—death : planting—corn spring *harvest* wheat
- 1 34 telephone—hear : spyglass—shout telegraph distance *see*
- 1 34 angels—heaven : men—*earth* women boys paradise
- 1 34 engineer—engine : driver—*horse* harness passenger man
- 1 32 polite—impolite : pleasant—*disagreeable* agreeable man face
- 1 32 prince—princess : king—palace *queen* president kingdom
- 1 32 wool—sheep : feathers—pillow rabbit *bird* goat bed
- 21 . 1 30 egg—bird : seed—crack *plant* grow nest
- 1 30 skin—body : bark—*tree* dog bite leaf
- 1 26 clock—time : thermometer—watch warm bulb mercury *temperature*

3 0

- 1 25 skating—winter : swimming—diving floating hole *summer*
- 1 22 hour—minute : minute—man week *second* short
- 1 22 Washington—Adams : first—contrast best *second* last
- 20. ... 1 20 cannon—rifle : big—*small* bullet gun army
- 1 20 parents—command children—order shall *obey* must
- 1 16 giant—dwarf large—dog monster queen *small*
- 1 16 1—2 : 3—4 2 6 9
- 19 ... 1 14 man—home : bird—*nest* fly insect free
- 1 14 corn—horse : bread—daily flour *man* butter
- 1 14 wool—sheep : fur—*cat* bird hat coat
- 1 11 good—bad : sweet—taste conduct *sour* polite
- 1 11 roof—house : hat—shoe straw attic *head*
- 1 11 go—come : sell—leave *buy* money paper
- 18. . 1 09 roof—house : hat—button shoe straw *head*
- 1 09 wrist—cuff : neck—leg giraffe foot *collar*

2.5

- 17...1.07 suitcase—clothing : purse—purchase *money* string stolen
 1.07 *Washington—Adams :: first—last worst *second* best
 1.07 able—unable :: strong—muscle exercise axe *weak*
 1.00 sailor—navy :: soldier—gun cap hill *army*
 1.00 pitcher—milk :: vase—*flowers* pitcher table pottery
 1.00 white—black :: good—mother time clothes *bad*
 16...0.98 uncle—nephew :: aunt—*niece* brother sister cousin
 0.98 December—Christmas :: November—month *Thanksgiving*
 December early
 0.98 terrier—dog :: Jersey—city *cow* horse state
 0.98 straw—hat :: leather—feather cool soft *shoe*
 0.94 airplane—air :: submarine—dive engine ship *water*
 0.94 dog—puppy :: cat—tiger dog horse *kitten*
 15...0.90 *locomotive—train : horse—station hut baggage *buggy*
 0.90 dress—woman :: feathers—neck feet bill *bird*
 0.90 food—man :: gasoline—gas oil *automobile* spark

2.0

- 14...0.86 above—below :: top—spin *bottom* surface slide
 0.86 table—wood :: stove—bottle paper *iron* cork
 0.86 skirts—girl :: trousers—hat vest *boy* coat
 13...0.82 abide—depart :: stay—over home play *leave*
 0.77 locomotive—coal :: automobile—motorcycle smoke wheels
 gasoline burn
 0.77 theatre—people :: hive—thrive sting *bees* thick
 12...0.73 shoe—foot :: hat—coat nose *head* collar

1.5

- 11...0.66 handle—hammer :: knob—key *door* shut room
 9...0.59 doctor—patient :: lawyer—nurse hospital court *client*
 0.59 gun—shoot :: knife—run *cut* hat bird

1.0

- 6...0.40 cradle—baby :: stable—*horse* man dog cat
 *Used as samples in the instructions to subjects

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