Age, familiarity, imagery, pronunciability, and meaningfulness of verbal units of factual information

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Limitations of available norms of attributes of verbal stimuli initiated this assessment of attributes of verbal units of topics of factual information. The attributes were ratings of age (A), familiarity (F), imagery (I), pronunciability (P), and meaningfulness (m') of these units and of 24 nouns from Paivio, Yuille, and Madigan's (1968) list. The *rs* between means for A, F, I, m', and m ranged from .87 to .97 for 64 units that served as responses in verbal learning, from .61 to .92 for 32 units that served as stimuli, and from .72 to .92 for the 24 nouns. The *rs* that involved P were somewhat lower.

Brown (1976) cataloged 172 sources of "scaled verbal materials" (letters, CVCs, words, etc.). Few, if any, of these sources are useful for those who wish to construct and use particular topics of factual information in prose and other formats in investigations of verbal behavior and verbal learning. Many sources are limited or excluded because the stimuli are all, or substantially, nonwords or words of only one or two grammatical functions that cannot readily be pooled across different norms. The grammatically heterogeneous words of some norms of word association are small in number and their attributes are limited to those derivable from distributions of associations.

Were norms for several attributes of a considerable number of grammatically heterogeneous words now available, they might still be of limited use for investigations of verbal behavior and verbal learning with coherent factual information on some topic(s). Short of a list of many thousands of words, it is unlikely that previously calibrated lists, word-frequency counts excepted, would contain all of the critical words of many topics of factual information.

When attributes of constituent verbal units of factual information are not manipulated, norms for these attributes may be dispensable. This is a short-run solution. In learning with particular topics, attributes of constituent units may be as important as they are in learning lists of single units or of paired associates (Goss & Nodine, 1965; Paivio, 1971). Moreover, particular topics should be describable by values of attributes of their constituent verbal units. New topics can then be compared with topics used previously. Most importantly, possible interactions between these attributes and other variables can be explored.

Described here are the procedures and outcome of a calibration of attributes of verbal units that were constituents of factual information on several topics. One attribute was the number of different associations to a verbal item that were written or produced in 30 sec, produced or associative meaningfulness, (m); the other attributes were ratings of age (A), familiarity (F), visual imagery (I), pronunciability (P), and number of associates or rated meaningfulness (m'). These particular attributes are among those assessed frequently (Goss & Nodine, 1965) and those included in some recent calibrations of large numbers of words (Brown & Ure, 1969; Paivio, Yuille, & Madigan, 1968; Stratton, Jacobus, & Brinley, 1975). Moreover, they are among the most potent in the learning of lists of single units and paired associates constituted of various kinds of verbal stimuli (Goss & Nodine, 1965; Paivio, 1971).

METHOD

Verbal Units

The topics of factual information had been selected and constructed de novo for an investigation of effects of study format and test format on acquisition and retention. These topics were selected within criteria of: (1) variety of content; (2) similarity of content to that encountered in school and popular sources, but unfamiliarity of the particular content to subjects; and (3) representation in 4 by 4 or 4 by 2 by 2 matrices. In these matrices, row and column headings were words or phrases and cell entries were names, words, phrases, or dates. The particular topics were "Carnivorous Plants," "First Women in Political Office," "Natural Resources of Central Africa," and "Things Invented Twice." Attributes of both matrix constituents and topic titles were scaled.

Ratings of A, F, I, P, and m' were along 7-point scales whose extremes were designated by, respectively, "heard, saw before kindergarten, seen for first time"; "familiar (heard, seen frequently), unfamiliar"; "definite visual image, no visual image"; "easy to say, hard to say"; and "many associations, no associations." The first member of each of these pairs was scored "7," and the second member was scored "1."

In order to compare values of attributes for these stimuli with values of attributes obtained for other stimuli in other

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sources, 24 nouns (four at each of six levels of imagery) that had been scaled previously by Paivio et al. (1968) were added.

Subjects

The 112 undergraduates who associated to and rated the verbal units were obtained from sections of the course in introductory psychology at Douglass College.

Procedure

Preparation of lists. For the first 96 subjects, the 124 verbal units, 25 for each of the 4 topics and the 24 Paivio et al. nouns, were divided into 4 lists of 31 units each. Each list consisted of one topic title, one row and one column heading from the matrix for each topic, one cell entry from each row and column of the matrices, and one noun from each of the six intervals of values for imagery. Headings and cell entries were the critical verbal units of presentation of factual information of the topics in prose, constrained prose, tabular, and paired-associate formats. This division of the 124 stimuli was done four times to yield four sets of four lists of units. Orders of the 31 units of each of the 16 lists were then randomized.

Each list of a random order of 31 units was accompanied by a computer-printout booklet of rating scales. The order of the five scales on each page of these booklets was randomized and their end points counterbalanced. Three subjects were assigned to each of 32 combinations of lists and end points. All units were rated by 24 students. Because the Paivio et al. (1968) nouns had occurred only with other nouns, they were also presented in an unmixed list to the remaining 16 students.

Presentation of lists. Students participated in groups, with random assignment of individuals to a particular list orientation. They had 30 sec to rate each unit, an average of 6 sec/scale.

After all 31 units were rated, the students turned to another random order of the same list. They had 30 sec to associate to each unit under instructions "to write down any other word, name, date, or phrase or the label of any visual image [that a stimulus might suggest to them, and to write] as many as you can."

RESULTS

Table 1 presents the means of ratings from "1" to "7" and of the number of different written associations. The first 24 nouns of the left column are from Paivio et al. (1968). The means are for those nouns mixed with the other verbal units.

The remaining units are for the four topics. The sequence within each topic is its title, the row headings of a matrix, the column headings, and the 16 cell entries. The latter are for successive columns of the first, second, third, and fourth rows.

An asterisk after a value that accompanies the Paivio et al. nouns indicates a significant difference from the mean for that noun in unmixed presentation [$t(30)$, $p < .05$]. Assuming independence, 6 differences among 120 at $p < .05$ could occur by chance. The rs for means of nouns in mixed and unmixed presentation were .97 for A, .91 for F, .96 for I, .82 for P, .95 for m' , and .90 for m. The rs for means of I in mixed and unmixed presentation and the Paivio et al. (1968) means for these nouns were .89 and .88, respectively. The corresponding rs for m were .80 and .76. All of these rs are at $p < .05$ on 22 df.

Correlation of Attributes

The lower left matrix of Table 2 shows the rs for means of A, F, I, P, m' , and m for the Paivio et al. nouns in mixed presentation. These rs are from .72 to .92; the lowest r is for I and P. All are at $p < .05$ on 22 df. The rs for I and m of .89 and .80 (not shown in Table 1) for mixed and unmixed presentation exceed the corresponding r of .72 obtained by Paivio et al. The rs between A, I, F, and m are equal to or considerably larger than the largest of the rs for 471 six-letter nouns and 72 five-letter words obtained by Stratton et al. (1975).

The rs in the upper right matrix between A, F, I, m' , and m are for the 64 cell entries; they range from .87 to .97, all of which are at $p < .01$ on 62 df. The rs that involve P are consistently lower, although still at $p < .01$. The former rs are consistently higher than those obtained by Paivio et al. for I, m, and concreteness, and by Stratton et al. for A, I, F, and m.

The rs for the 32 row and column headings for A, F, I, m' , and m ranged from .61 to .92; all were at $p < .01$ on 30 df. The values of these rs equaled or exceeded those obtained by Paivio et al. and by Stratton et al. The rs involving P were from .23 to .68; all but the r of .23 were at $p < .05$.

Attributes and Learning

The same course in introductory psychology was the source of 192 additional, different undergraduates who learned the cell entries as responses to row and column headings. The four sets of 16 cell entries were presented as separate topics for study in each of the four different formats. Learning with a particular study format was tested with each of four test formats. Test formats were obtained from study formats by deletion of the cell entries. Subjects reproduced the missing entries or reconstructed them (Luh, 1922). Correct reproductions and correct reconstructions were summed across trials. Because these totals were essentially invariant across formats, they were averaged across formats.

The last two columns of Table 2 show the rs between correct reproduction and correct reconstruction and A, F, I, P, m' , and m. Of the four rs for reproduction at $p < .05$ on 62 df, the largest accounted for only 16% of the variance in correct reproduction. None of the rs for reconstruction was at $p < .05$. Stepwise regressions of reproduction and reconstruction on stimulus attributes added nothing.

DISCUSSION

Calibration of Attributes, Correlations

The means of A, F, I, P, m, and m' of the cell entries, headings, and topic titles intermingled with means of the Paivio et al. nouns. Subjects can associate to and rate a list of stimuli that are heterogeneous in kind, length and CV structure, and grammatical function. Moreover, the equivalence of means of

Table 1
Means of Ratings of Age (A), Familiarity (F), Pronunciability (P), Imagery (I), and Meaningfulness (m'),
and of Produced Meaningfulness (m)

Item	A	F	P	I	m'	m	Item	A	F	P	I	m'	m
Advice	5.54	6.88	6.78	3.62	6.08	4.88*	Martha Cannon	1.29	1.25	6.46	1.92	1.42	2.00
Alcohol	5.67	6.62	6.75	6.12	6.50	5.83	Utah	5.38	5.58	6.38	5.21	4.29	5.08
Ambassador	4.54	5.75	6.42	5.17	4.75	4.33	1896	3.33	3.17	7.00	1.67	1.83	2.25
Bouquet	5.88	6.12	5.83	6.96	5.96	5.71*	Two Terms	4.75	5.83	6.62	3.75	4.75	4.04
Disparity	3.21*	4.50	5.12	2.88	3.12	2.08	Jeannette Rankin	1.29	1.46	5.58	1.50	1.12	1.33
Ego	3.79	6.67	6.88	3.75	6.00	4.17	Montana	5.08	5.21	6.54	4.96	3.88	4.38
Emancipation	4.00	5.46	6.17	3.75	5.04	4.25	1917	3.88	4.12	7.00	3.83	4.00	3.46
Emergency	6.04	6.33	6.58	6.21	6.54	5.42	Two Separate Terms	4.22	4.92	6.71	3.17	4.25	2.88
Epistle	3.00	3.17	5.29	2.58	2.75	2.58	Rebecca Felton	1.00	1.00	5.92	1.92	1.08	1.88
Functionary	3.21	4.50	5.58	2.58	3.88	2.58	Georgia	5.50	6.46	6.83	5.54	5.25	4.58
Gist	2.75	4.04	6.00	1.50	3.08	2.04	1922	4.50	4.54	6.92	3.88	3.96	3.54
Heaven	6.88	6.54	6.96	6.12	5.96	5.54*	2 Months	6.75	6.50	6.79	3.88	4.92	3.29
Interest	6.09	6.58	6.58	3.83	6.12	3.75	Natural Resources	3.52	4.09	6.27	3.91	3.18	2.71
Interim	3.04	4.46	5.21	3.38	3.50	3.04	of Central Africa	4.04	5.42	6.29	5.38	4.79	4.58
Maker	5.75	5.25*	6.58	4.26	4.70	3.83	Nigeria	3.29	3.88	6.35	3.29	2.96	3.38
Meeting	6.54	6.92	6.92	6.58	6.42	4.67	Central African	3.12	3.88	5.75	4.17	3.58	4.17
Misconception	3.67	6.21	5.88	2.92	4.54	2.96	Republic	2.12	2.17	5.54	1.88	1.83	3.00
Occasion	5.25	6.29	6.75	4.29	5.33	4.54	People's Republic	5.21	6.17	6.62	5.38	5.08	4.54
Retailer	4.21	6.12	6.67	4.38	4.29	4.00	of the Congo	4.83	6.50	6.00	5.00	5.54	5.92
Sea	6.79	6.96	7.00	7.00	6.58	7.12	Zambia	5.04	5.88	6.71	4.46	5.08	3.79
Shame	6.33	6.30	6.79	4.33	5.83	4.00	Mineral	4.50	4.75	6.33	3.38	4.12	2.67
Slipper	6.74	6.87	6.87	6.52	5.39	5.04	Agricultural	4.33	5.79	6.33	5.71	5.71	5.25
Surtax	3.08	4.21	6.58	2.12	2.96	3.38	Most Abundant	5.88	6.17	7.00	5.88	5.54	4.25
Warmth	6.88	6.88	6.79	6.08	6.83	5.83*	Next Most Abundant	6.21	6.42	6.50	5.79	5.71	5.17
Carnivorous Plants	3.54	4.38	5.58	4.83	3.71	3.50	Petroleum	6.25	6.62	6.62	6.71	6.25	5.88
Sticky Surface	2.50	2.65	6.17	4.08	3.00	2.96	Tin	6.17	6.67	6.54	6.71	6.25	6.25
Trap	1.39	1.88	6.21	3.08	1.83	1.96	Cocoa	4.00	5.25	6.29	4.25	4.75	3.67
Jug-of-Water Trap	2.33	2.04	6.62	3.46	2.42	2.79	Tobacco	6.83	6.92	6.96	6.71	5.71	5.88
Snap Trap	2.21	3.21	6.50	3.67	3.08	3.04	Diamonds	6.75	6.75	6.83	6.96	6.50	6.08
Suction Trap	6.12	6.62	6.71	4.12	5.46	3.58	Uranium	4.96	5.88	6.92	5.29	4.50	4.25
Example	6.12	6.50	6.88	4.00	5.62	3.67	Coffee	6.75	6.92	7.00	6.92	6.83	5.79
Found In	4.43	6.46	5.96	4.30	4.70	3.58	Cotton	2.96	2.79	6.62	3.25	2.96	3.96
Distribution	4.17	4.52	6.48	4.35	4.57	3.67	Lead	3.00	3.33	6.54	3.83	3.71	3.42
Largest Prey	1.25	1.62	5.21	1.62	1.38	1.62	Copper	5.62	6.67	6.92	6.25	5.46	4.42
Butterwort	4.71	5.46	6.71	6.00	4.88	5.58	Zinc	4.04	5.42	6.96	4.58	3.67	4.04
Marshes	5.38	6.54	6.92	6.04	6.12	5.62	Corn	7.00	6.88	6.92	7.00	6.42	6.33
Canada	6.96	6.79	6.88	7.00	6.12	5.75	Wheat	6.00	6.38	6.96	6.88	5.88	5.71
Spiders	1.83	1.79	6.42	2.71	1.75	2.33	Things Invented	3.88	3.22	6.57	2.35	2.52	2.46
Pitcher Plant	2.50	3.08	6.00	3.62	2.79	4.25	Twice	6.12	6.92	6.79	6.79	5.75	5.79
Costal Bogs	4.29	5.50	6.25	5.21	4.96	4.54	Typewriter	3.46	6.62	6.54	6.79	6.17	5.33
Eastern U.S. and	6.75	6.75	7.00	7.00	6.17	5.17	Calculator	6.50	6.79	6.83	6.79	6.00	5.71
S.E. Asia	4.42	5.21	6.50	5.92	4.04	4.38	Sewing Machine	5.42	5.50	6.83	6.71	5.12	4.12
Mice	5.58	6.08	6.88	6.58	5.92	5.46	Steam Engine	3.77	4.08	6.58	4.13	3.92	2.54
Venus' Flytrap	5.46	6.38	6.75	5.21	4.79	4.46	First Working Model	2.54	3.12	6.38	2.67	3.09	3.12
Swamps	6.67	6.71	6.75	6.67	5.54	4.67	First Practical Model	5.67	6.17	6.58	5.33	5.75	3.92
North Carolina	1.42	2.00	5.79	2.38	1.79	1.79	Henry Mill	1.08	1.25	6.79	1.54	1.38	1.75
Grasshoppers	6.71	7.00	6.96	7.00	6.75	6.04	1714	3.92	2.75	6.62	1.83	2.12	2.58
Bladderwort	5.77	6.52	6.83	6.04	6.12	4.21	Christopher Sholes	1.17	1.25	5.71	1.54	1.38	2.29
Lakes	6.29	5.62	6.88	6.62	4.67	5.50	1873	3.38	3.17	6.92	2.08	2.08	2.50
Europe and North	2.83	4.83	6.88	4.70	3.83	2.38	Blaise Pascal	1.79	1.75	4.21	2.00	1.79	1.71
America	3.29	4.38	6.71	4.42	3.88	2.50	1643	3.33	2.33	6.79	1.92	1.92	2.25
Tadpoles	2.79	3.33	6.58	3.42	2.54	2.58	Gottfried Von Leibur	1.22	1.13	3.52	2.09	1.39	2.54
First Women in	2.79	3.83	6.21	3.54	3.21	2.58	1673	3.21	2.21	6.67	2.04	1.62	3.29
Political Office	2.54	4.25	6.54	2.71	2.54	2.75	Thomas Saint	1.62	1.52	6.58	1.87	1.65	2.17
First Woman Mayor	6.92	7.00	6.96	4.58	6.54	4.79	1780	3.57	2.78	6.87	2.13	2.13	3.48
First Woman State	6.21	6.96	6.88	6.08	6.21	5.42	Elias Howe	2.25	2.12	5.29	1.96	1.92	2.08
Senator	6.57	7.00	6.98	5.85	6.55	5.00	1846	3.79	3.08	6.62	2.04	2.08	2.58
First U.S.	4.92	5.04	6.75	4.08	4.38	4.21	Dionysius Papin	1.33	1.29	2.38	1.25	1.33	2.00
Congresswoman	1.08	1.38	5.96	1.42	1.29	2.17	1690	3.08	3.25	6.79	2.25	2.12	3.17
First Woman U.S.	5.42	6.12	6.96	5.00	5.17	4.21	James Watt	1.92	2.25	6.79	1.58	1.75	2.83
Senator	3.25	3.29	6.75	2.38	2.42	2.62	1765	3.79	3.21	6.62	3.12	3.33	2.71
Name	6.67	6.52	6.96	3.65	5.65	3.79							

*Word occurred twice; mean based on 48 students.

attributes for the Paivio et al. nouns in mixed and unmixed lists suggests that means of attributes may be invariant over different contexts of other verbal units.

The *rs* for *I* and *m'* for the 24 Paivio et al. nouns in mixed and unmixed lists and their Paivio et al. values agree closely with the corresponding *rs* of .90 and .71 for 61 nouns common to the Paivio et al. and Stratton et al. lists. These agreements are consistent with other relatively high correlations among the same and similar attributes for different samples of subjects (Brown & Ure, 1969; Goss & Nodine, 1965).

Carrol and White (1973) found *A* to be a better predictor of latency of names of pictures of objects than counted word frequency. The *r* between *A* and *F* of verbal items in this study was .96. Rather than *A*, White and Carroll may provide another finding, although indirect, that *F* is a better predictor than counted word frequency.

Attributes and Learning

Correct reproduction required integration of cell entries and their consequent availability as well as formation of relation-

Table 2
Matrices of r_s Between Stimulus Attributes of the Paivio et al. Nouns (Lower Left) and Between Stimulus Attributes of the 64 Cell Entries (Upper Right), and of r_s Between Stimulus Attributes and Correct Reproduction (reP) and Correct Reconstruction (reC)

	A	F	I	P	m'	m	reP	reC
A		.96	.92	.54	.97	.89	.21	-.06
F	.81		.89	.57	.93	.87	.32	.02
I	.85	.74		.45	.95	.95	.40	.06
P	.72	.78	.55		.49	.46	.04	-.13
m'	.87	.92	.80	.73		.91	.36	.04
m	.82	.78	.89	.70	.85		.31	-.03

ships between row and column headings and cell entries. Cell entries were already integrated and available for correct reconstruction which was not related to attributes of cell entries. The relationship between reproduction and F, I, m', although not strong, might then be interpreted as due to effects of these attributes on integration availability of cell entries.

A further suggestion that attributes of cell entries do not influence formation of relationships between row and column headings and cell entries does not follow unequivocally from the data obtained here. Cell entries differed in kind among columns, and column headings or their equivalent in prose indicated where such entries were to be placed. These cues may have been sufficiently facilitative to obscure any effects of attributes of individual cell entries on formation of relationships between headings and entries.

REFERENCES

- BROWN, A. S. Catalog of scaled verbal material. *Memory & Cognition*, 1976, 4, 1S-45S.
- BROWN, W. P., & URE, D. M. J. Five rated characteristics of 650 word association stimuli. *British Journal of Psychology*, 1969, 60, 233-249.
- CARROLL, J. B., & WHITE, N. M. Age-of-acquisition norms for 220 picturable nouns. *Journal of Verbal Behavior and Verbal Learning*, 1973, 12, 563-576.
- GOSS, A. E., & NODINE, C. F. *Paired-associates learning*. New York: Academic Press, 1965.
- LUH, C. W. The conditions of retention. *Psychological Monographs*, 1922, 31, No. 142.
- PAIVIO, A. *Imagery and verbal processes*. New York: Holt, Rinehart, & Winston, 1971.
- PAIVIO, A., YUILLE, J. C., & MADIGAN, S. A. Concreteness, imagery and meaningfulness values for 925 nouns. *Journal of Experimental Psychology Monograph Supplements*, 1968, 76(1, Part 2).
- STRATTON, R. P., JACOBUS, K. A., & BRINLEY, B. Age-of-acquisition, imagery, familiarity, and meaningfulness norms for 543 words. *Behavior Research Methods & Instrumentation*, 1975, 7, 1-6.

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