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PSYCHOLOGICAL STUDIES IN SEMANTICS: I. FREE ASSOCIATION REACTIONS TO WORDS, DRAWINGS, AND OBJECTS*

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A. INTRODUCTION

Korzybski (6) and Ogden and Richards (11), in pointing out the social and practical implications involved in the use of words, have particularly stressed the confusion introduced into thinking because words are equivocal in meaning. Korzybski treats words in terms of degrees or orders of abstraction, with the warning that failure to appreciate the order of abstraction in which thought is taking place may lead to confusion and error in judgment causing, in turn, personal maladjustment. Ogden and Richards speak of the remoteness of the particular word from its "referent" and emphasize the difficulties thus introduced into ordinary communication. These leaders in modern semantics have called attention to the practical value of a language composed of words having specific meanings. Korzybski would greatly increase our vocabulary by introducing more specific terms in the attempt to give language mathematical precision. Ogden and Richards have stressed the desirability of eliminating some of the vagueness in ordinary communication by limiting it to a minimum of fairly common words with very definite meanings. Ogden has, in fact, presented such a list of words in the form of a *Basic English Vocabulary* (10).

However difficult it may be to assess in detail the final significance of the work of such modern semanticists, their general thesis of the basic influence of words and language on thought processes is doubtless of the highest importance. They have shown that words are never superfluous, can never be lightly dismissed as irrelevant, but that in the processes of thought, words, no matter how seemingly inconsequential, basically affect and can fundamentally change the entire pattern. The associationist psychologists, of course, have worked extensively with words; but more recently psychologists have largely attempted to isolate the processes of thinking in terms of problem

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solving. Such problems are amenable to specific laboratory formulation and unquestionably of the highest importance, yet they quite evidently do not get at the subtle effects set up in the process of thinking by the nature, number, kind, and type of relation of the words and ideas that accompany problem solving. In this series of papers we have adopted the basic thesis of the semanticists; in view of the fundamental relations of thought and language our attempt, primarily, is to study experimentally the various internal relations of word symbols, their relation to the process of thought, and ultimately to personality structure.

The purpose of this initial article is to determine experimentally the responses to stimuli representing three different levels of abstraction. Objects, line drawings of the objects, and the names of the objects are conceived as representing an increasing order of stimulus abstraction. The method of free association was used and reaction times were obtained. This study was undertaken since the question whether or not the method of free association responses to words is relevant to problems of thinking sets up a preliminary problem, the comparison of free associations for words and for objects in order to determine to what extent these two kinds of free association are related. Since the history of this problem is meager and since Woodworth has referred to what experimental evidence there is, the following rather full quotation from Woodworth (12) is given as an historical and critical orientation.

The great frequency of coördinate and contrast response in adults need not be interpreted as indicative of a strong tendency to think in these terms. The experiment as usually carried out is distinctly an experiment with words. When, instead of color names, actual bits of color were shown to college students (Dorcus, 1932) (1, 2) with instructions to write the first word thought of other than the name of the color itself, the response words were mostly names of objects, and very few coördinate colors were named. We are not to suppose that seeing a color commonly leads the adult to think of another color, but only that one color *name* tends to suggest another color name when the task is to give word responses. More in general, the frequency of opposites and coördinates in the responses of adults need not mean that "association by contrast" or by coördination is specially characteristic of adult thinking; for, again, the experiment is bound up with the use of words.

More recently Lorge and Thorndike (7, 8) have questioned verbal replies in general and the free association tests in particular as any adequate indication of "the real behavior of the person toward things, people, animals, art, music, beauty, responsibility, etc."

B. THE EXPERIMENT

I. *Procedure and Apparatus*

Two adjoining rooms containing a two foot square opening in the common wall were used. The subject was seated in an easy chair in one of the rooms. On the arm of the chair was a writing pad which could be lighted by a small six volt bulb. The room was noise-free and dark. Near the subject was placed a carbon microphone whose sensitivity could be controlled by the operator in the adjoining room.

A revolving stage occupied the window between the two rooms. It was divided into four sectorized chambers so arranged that no light could enter from the experimental into the subject's room. Opposite quarters of the stage were exposed at the same time to the subject and operator respectively. The entire staging was completely lined with black velvet in order to obtain even illumination of the visual field.

The subjects were instructed to speak into the microphone the first thought that came to mind, other than the name of the stimulus. Five practice items were presented before the experimental list of 25. Altogether 120 subjects were used: 40 for words, 40 for drawings, and 40 for objects. The words were printed in 3/4 inch letters on white cards 3 by 14 inches. Drawings were made in India Ink on white card boards 4 by 11 inches. The observers, who sat about six feet from the stimuli, reported no difficulty in seeing them clearly.

The operator sat in front of a synchronous clock which measured in 1/100ths of a second. The clock has a rated inertia of 1/250ths of a second. In front of the operator was a key which when closed completed the circuit of a 1.5 volt buzzer. This buzzer constituted the "ready" signal for the subject. A few seconds after the signal a double-throw, double-pole switch simultaneously lighted the stage in front of the observer and completed the circuit of a buzzer placed in a sound-proof box containing the carbon microphone. Its excitation by the buzzer click, relayed through the conventional 885 voice key hook-up, started the electric clock. Excitation of the subject's microphone by the spoken response stopped the clock through the same amplification layout. The experimenter could then record the time which elapsed between the illumination of the stage and the subject's reply. The operator threw the DPDT switch to the position which lighted the subject's writing pad. While the subject jotted down the response, the experimenter changed the item on the portion of the revolving stage exposed to him. Next the operator threw the DPDT switch to its neutral position,

thus leaving the subject's room entirely dark. The stage was then revolved 1/4 turn. The warning buzzer was given and the whole process was repeated.

2. *Selection of Items*

The selection of the items was subject to the following limitations. It was desirable to use items which were nearly equal as stimuli whether presented as a word, drawing, or object. This task was difficult since few, if any, basic words, are so specific in meaning as to be exhaustively represented by a particular object or drawing. Again, since the stimuli were presented visually, a practical limitation in item selection was imposed by the dimension of the stage on which they were exposed. The selected items in the order presented are as follows. (In order to control the contextual associations within the series half the subjects were given the items in reverse order.)

1. light bulb	14. fork
2. screw driver	15. rolling pin
3. pipe	16. mouse trap
4. leaf	17. book
5. shoe	18. apple
6. funnel	19. kettle
7. dollar	20. comb
8. candle	21. spoon
9. baseball	22. bone
10. cup	23. scissors
11. pencil	24. cigarette
12. hammer	25. basket
13. pistol	

C. ANALYSIS OF FREE ASSOCIATION WORD RESPONSES

Since the data are of two kinds—free association responses and reaction times—the results are considered separately under captions *C* and *D*.

An analysis of word responses has been made by two methods. (a) In terms of frequency distributions of the most common responses and (b) in terms of kind or type of response.

1. *Frequency Distributions*

By means of frequency distributions of the most common responses given to each of the 25 items at the three levels of abstraction, correlations and the significance of the differences of the means for the three levels of stimulation may be derived. Table 1 contains the obtained distributions.

TABLE 1
FREQUENCY OF THE MOST COMMON RESPONSE

No. of subjects	Verbal level	Pictorial level	Object level
34	1		
32			
30			1
28	1	1	1
26	2	3	
24	1	2	2
22		2	
20	4	3	4
18	3	2	2
16	2	2	1
14	3	2	3
12	3	2	4
10	3	3	4
8		2	2
6	2		
4	1		1
Mean	16.32	18.64	16.25
σ of distribution	6.13	6.82	6.38
σ of mean	1.23	1.32	1.30

One may read from this table that there is one stimulus word on which 34 individuals out of a possible 40 agree on a single most common response. At the bottom of the distribution one may read that there is one word on which not more than four individuals agree on any one response.

Table 2 presents the critical ratios (the difference between the means

TABLE 2

	Diff. between means	Difference σ diff.	Correlation
Pictorial and object levels	2.39	1.96	.58
Verbal and pictorial levels	2.32	1.84	.53
Verbal and object levels	.07	.05	.41

divided by the sigma of the difference) and the rank-difference correlations between the frequencies of the most common responses for the different levels of stimulation.

For 17 of the stimulus items, the most common response at each level was the same word. For the remaining eight items the most common responses were not the same for all three levels. Table 3 lists these items with the frequencies of their most common responses.

The frequency distribution in Table 1 indicate that in terms of the common responses the distributions for the three levels are superficially similar.

TABLE 3

Stimulus	Verbal Response Frequency		Pictorial Response Frequency		Object Response Frequency	
Dollar	bill	13	money	18	money	28
	money	10	bill	2	bill	1
Cup	saucer	18	drink	15	tea	13
	drink	10	tea	8	drink	12
	tea	3	saucer	0	saucer	2
Fork	knife	20	eat	17	eat	12
	eat	6	knife	7	knife	8
Kettle	pot	10	water	11	water	14
	water	2	pot	0	pot	0
Comb	brush	19	hair	34	hair	25
	hair	18	brush	2	brush	2
Spoon	fork	16	eat	12	eat	13
	eat	4	fork	4	fork	1
Bone	dog	12	dog	29	meat	9
	meat	2	meat	0	dog	8
Basket	ball	11	carry	8	carry	8
	carry	1	ball	0	ball	1

The critical ratios of the differences of the mean divided by the standard error indicate that the differences are not statistically reliable. However, the differences between words and objects are less reliably, considerably, than those between words and drawings or between drawings and objects. In Table 3 it is interesting to note that in the case of some of these items the response on the verbal level tends to be a verbal habit such as dollar-bill, basket-ball or an attempt to discriminate the object in terms of associated objects, e.g., cup-saucer, fork-knife.

2. Kind or Type of Response

In order to make a more detailed analysis of the data in terms of qualitative differences in responding to words, objects, and drawings it was necessary to utilize a schema for classifying the individual responses. The following series of definitions seems to outline an adequate system of classification for free association responses. (A more complete discussion and critical evaluation of this system will be given in the following articles of this series.)

An Essential Contrast is one in which, in some given context, what is

meant by the stimulus word and what is meant by the response word mutually exclude each other by direct opposition, e.g., man-woman, fill-empty.

A *Synonymous Identification* is one in which, in some given context, what is meant by the stimulus word implies or is included in what is meant by the response word and vice versa, e.g., friend-pal, length-long. A *General Identification* is one in which in some given context, what is meant by the stimulus word implies or is included in what is meant by the response word but not vice versa, e.g., ball-round, bread-food. A *Specific Identification* is one in which, in some given context, what is meant by the response word implies or is included in what is meant by the stimulus word but not vice versa, e.g., food-oyster, length-yard.

A *Contingent Contrast* is one in which, in some given context, what is meant by the stimulus word and what is meant by the response word do not mutually exclude each other, but are commonly related in experience as opposed to each other coördinately or gradiently, e.g., city-state, floor-wall. A *Contingent Identification* is one in which, in some given context, what is meant by the stimulus word and what is meant by the response word do not necessarily imply or include each other, but are commonly related in experience as characterizing the same object or act, e.g., hair-brown, egg-breakfast.

By *Operation* is meant a relation between the stimulus and response word such that the one defines the other in terms of some characteristic and specific action, e.g., pencil-write, scissors-cut.

Table 4 is an analysis of the responses in terms of the above categories. The table is broken up into separate parts for the verbal, the pictorial, and the object levels. The first five columns represent the total word list broken down into ordered groups of five items each. The last column contains the results for the total list of 25 items. The numbers in the columns are percentages of the total number of responses which fall in the various categories given by the 40 subjects to the given number of items. Since not all responses were classifiable the total percentage tally is less than 100.

Examination of the percentages for the total list of items which are presented in the last column of Table 4 shows that although the categorical percentages vary for the three levels of stimulation, nevertheless, if the percentage for any one category is high at one level it tends to be relatively high at the other levels and vice versa. This would indicate that the fundamental associative processes operate in a similar heirarchical order for the three levels of stimulation. The rank difference correlation between

TABLE 4

	Items 1-5	Items 6-10	Items 11-15	Items 16-20	Items 21-25	Items 1-25
<i>Verbal Level</i>						
Essential Contrast	.000	.000	.000	.000	.000	.000
Synonymous Identification	.005	.015	.015	.060	.000	.021
General Identification	.250	.325	.175	.325	.095	.234
Specific Identification	.190	.030	.000	.015	.050	.057
Contingent Contrast	.125	.185	.380	.175	.230	.217
Contingent Identification	.090	.160	.130	.155	.315	.170
Operation	.180	.085	.265	.215	.220	.193
Per cent of responses classified	.840	.800	.965	.945	.910	.694
<i>Pictorial Level</i>						
Essential Contrast	.000	.000	.000	.000	.000	.000
Synonymous Identification	.000	.010	.005	.010	.020	.009
General Identification	.305	.330	.175	.445	.030	.257
Specific Identification	.210	.020	.000	.030	.005	.053
Contingent Contrast	.020	.045	.230	.025	.050	.074
Contingent Identification	.075	.235	.125	.095	.470	.200
Operation	.245	.215	.435	.325	.375	.319
Per cent of responses classified	.855	.855	.970	.930	.950	.912
<i>Object Level</i>						
Essential Contrast	.000	.000	.000	.000	.000	.000
Synonymous Identification	.005	.005	.005	.020	.055	.018
General Identification	.320	.340	.155	.435	.060	.262
Specific Identification	.160	.010	.010	.020	.015	.043
Contingent Contrast	.030	.055	.195	.025	.085	.078
Contingent Identification	.085	.275	.150	.105	.325	.188
Operation	.295	.205	.455	.345	.395	.339
Per cent of responses classified	.895	.890	.970	.950	.935	.928

the categorical order of the pictorial and the object levels is $+1.00$, that between the verbal and pictorial levels and verbal and object levels $+.71$. Even though the serial order is similar, however, within this order there are significant differences in degree or quantity of response for some of the categories at the different stimulation levels. This difference is most pronounced for the operational and contingent contrast categories. Therefore, as compared to pictures and objects, words may be said to call forth fewer operational responses and more contingent contrast responses than either drawings or objects. This is the most important distinction between verbal, object, and pictorial stimuli revealed in this study. Words also tend to give a larger proportion of unclassifiable responses as is indicated

TABLE 5

Categories	R	PE	Average No. responses		Difference	σ dis.	σm	σ diff.	difference σ diff.
			per item	per item					
Gen. Iden.									
words—objects	.83	.042	9.36	10.48	1.12	9.1	1.83	2.02	.985
words—drawings	.91	.023	9.36	10.28	.93	9.1	1.83	2.01	1.116
objects—drawings	.88	.034	10.48	10.28	.20	10.09	2.02	2.01	.195
Cont. Cont.									
words—objects	.46	.106	8.68	3.16	5.52	8.95	1.79	1.04	3.441
words—drawings	.53	.097	8.68	3.00	5.68	8.95	1.79	1.12	3.719
objects—drawings	.74	.061	3.16	3.00	.16	5.17	1.04	1.12	.261
Cont. Iden.									
words—objects	.83	.042	6.80	7.52	.72	6.08	1.21	1.35	.950
words—drawings	.80	.049	6.80	8.00	1.20	6.08	1.21	1.68	1.180
objects—drawings	.79	.051	7.52	8.00	.48	6.74	1.35	1.68	.471
Operation									
words—objects	.87	.033	7.72	13.56	5.84	7.97	1.49	1.63	7.236
words—drawings	.90	.026	7.72	12.76	5.04	7.97	1.49	1.74	6.661
objects—drawings	.93	.015	13.56	12.76	.80	8.13	1.63	1.74	1.171

by the number of responses classified for the three levels. For words, out of 1000 possible responses only 894 were classifiable, for pictures 912 and for objects 925. Words give more phrase-completion and clang responses than either pictures or objects.

Table 5 gives a clear picture in quantitative terms of the following inter-relations: (a) that the pattern of associative processes underlying the three levels is qualitatively similar and (b) that within this common operational framework the responses vary quantitatively. This first point is demonstrated by the presence of correlation between the three levels of stimulation for each of the categories, the second by the presence of significant differences in the amount of response within the categories. (The categories of essential contrast, synonymous identification, and specific identification are not included since a sufficient number of responses were not available for statistical analysis.) The table shows the correlations obtained when the original scores are taken as deviations from zero. The scores are the number of responses of a given category given for each of the 25 items when presented at different levels of stimulation. The bulk of the table gives the statistical data required to determine the reliability of the differences between the average number of responses of a given category for different levels of stimulation.

Inspection of the data shows that the responses on the three levels of stimulation for all categories except contingent contrast are highly correlated. Since the responses for this category were largely on the verbal level with many blanks for individual items on the pictorial and object levels, the relatively lower correlation for contingent contrast as compared to the other categories may be due to insufficient sampling. The critical ratios in the last column show that in the case of the categories for contingent contrast and operation the differences in response to words and objects and words and pictures are statistically significant.

In order to indicate to what extent particular items rather than the general stimulation level is responsible for the differences in the operational and contingent contrast categories, the percentages of groups of five items are given in Table 4. This analysis does in fact reveal that in some cases the differences between clusters of items is as great as, if not greater than, the differences across categories. For example, in the specific identification category the percentage for the first five items is much greater than for any of the succeeding clusters of items. It was found that the item "leaf" was largely responsible for this piling up of responses. When this word was

eliminated from the cluster and the percentages recalculated on the basis of four items the percentage dropped from .190 to .031 on the verbal level, from .210 to .025 on the pictorial level, and from .160 to .031 on the object level. Whether the word "leaf" is eliminated or retained, however, the numerical order of the percentage in the final column representing the total list of items remains constant with reference to the other categories. The items "kettle" and "hammer" introduce similar discrepancies for the clusters of which they are members. These words have ambiguous meaning which are brought out sufficiently by the free association technique to put them out of line with reference to the remaining items.

D. ANALYSIS OF FREE ASSOCIATION REACTION TIMES

Experimentally we had a choice either of presenting the items at all three levels of stimulation to the same subjects or of presenting the items at the different levels to separate groups. The latter method was chosen in order to avoid establishing sets for responding to any class of items as words or drawings or objects depending on the initial level of stimuli. To control the factor of transfer of set from one level to another would have required a much larger number of subjects than could be managed. On the other hand, the alternative method of using separate groups involves the difficulty that a random selection of subjects may yield groups differing in their ability to react quickly to the stimuli. To avoid this problem one should, of course, use equated groups, but this solution was not feasible. However, we did try to obtain similar groups in that the subjects were taken from pre-medical students, a highly selected class, and from students registered in the social science division who were taking Psychology 1. To further minimize individual differences a large number of subjects were used, and these in turn were divided into groups of 30. There were four such sub-groups. The 1st and 4th groups were made up entirely of pre-medical students, the 3rd and 4th groups composed of both pre-medical and social science students. Each sub-group was further subdivided in that 10 subjects each, selected by chance, were presented words, drawings, and objects.

The total subject population was broken up into sub-groups to determine the variation of the mean reaction time for the three levels of stimulation in terms of four different groups. It is unlikely that four samples of the subject population would by chance be so set up that subjects having special ability to react to words or objects or drawings would tend to be grouped

for that level for which they might have such special aptitude. Consequently, if the means for all four groups vary consistently for the different levels of stimulation it would then be difficult to attribute the differences of the means to differences between subjects. Table 6 contains the mean reaction

TABLE 6
AVERAGE REACTION TIMES

Population basis	Population size	Pictorial level	Object level	Verbal level
Group One	30	1.60	1.72	1.53
Group Two	30	1.70	1.38	1.44
Group Three	30	1.82	1.66	1.44
Group Four	30	1.79	1.64	1.41
Group One and Two	60	1.65	1.55	1.49
Group One and Four	60	1.69	1.68	1.47
Group Two and Three	60	1.77	1.52	1.44
Group Four and Three	60	1.81	1.65	1.42
All four groups	120	1.73	1.60	1.46
Items	25	1.73	1.60	1.46

times for the four groups and combinations of the four groups. This table indicates that the shift in the means is quite consistent for the four groups and, therefore, that the differences in the means are attributable to the level of stimulation rather than to any favorable chance selection of individual differences in the groupings.

In determining the reliability of the difference between the mean reaction times at the three levels of stimulation the reaction times of both the subject and item populations were analyzed. Ordinarily one would prefer to analyze the subject population but in as much as three separate groups were used for the three levels of stimulation it is impossible to obtain correlations in terms of subjects for the different levels. Since it is highly probable that if the same subjects were given all three forms of stimulation a positive relation would be indicated, the question is raised whether the reliabilities of the differences between means as determined on the basis of uncorrelated measures (as they must be because of the method of experimentation used) are representative of the facts. We therefore made an analysis of the item population because the items being the same at all three levels it was possible to obtain correlations between the items presented at the different levels. Table 7 contains the sigmas of the item and subject population and the *SE* of the means of item and subject distributions for the three levels of stimulation. Table 8 contains the correlations

TABLE 7

	Drawings	Objects	Words
Mean reaction time	1.73	1.60	1.46
σ dist. of item population	.291	.263	.199
σ dist. of subject population	.509	.383	.348
σ mean of item population	.058	.053	.040
σ mean of subject population	.080	.060	.052

TABLE 8

	Correlations	Difference	Difference σ diff.(items)	Difference σ diff.(subjects)
Pictorial and Verbal	.49	.27	4.79	2.87
Object and Verbal	.53	.14	3.01	1.77
Pictorial and Object	.54	.13	2.32	1.30

of the item distribution by the rank difference method, the differences between means, and the difference divided by the difference for both the object and item populations.²

The larger values of the sigmas in the case of the subject population indicates that the reaction times vary more for subjects than for items. The critical ratios between the differences in the means shown in Table 8 indicate that the differences between the means for the pictorial and verbal levels are statistically significant since in both cases the critical ratio is greater than 3. This statement is not true for the subject population, but as pointed out above, these ratios are not so representative of reaction time data as they might be since the ratios were determined with uncorrelated measures.

The difference between the means for the pictorial and object levels is not statistically significant, but the direction of the difference, indicating that the reaction is longer on the pictorial level, is probably genuine. Introspective reports indicating that line drawings require more interpretation as meaningful symbols than either words or objects may account for the relatively slower reaction time of pictures as compared with objects. The statistically significant difference between the mean reaction times for the

²The statistical measures in this article were obtained by conventional formulae based on the normal probability curve. Reaction time distributions show a definite and characteristic skew towards the shorter times. The frequency distributions for reaction times for the different categories are remarkably similar in shape. This fact makes the use of conventional statistical measures less objectionable. There is a need for convenient statistical formulae based on the typical skewed distribution of reaction time data (4).

verbal and object levels seems to represent a fundamental fact. The most probable interpretation of this is that no intermediary symbol is required between word as stimulus and word as response, whereas with objects as stimuli a secondary symbol mediates between the original stimulus and the response. This tends to be introspectively substantiated since in the case of some subjects who utilize visual imagery we obtained rather definite introspective reports that the object provoked a visual image whereas with verbal stimuli the word tended to call up another word immediately.

As we conceive it the situation which obtains between the three levels of stimulation and the verbal responses may be represented diagrammatically as follows:

Word stimulus—word response; object stimulus—intermediary symbol (usually visual image or word)—word response; pictorial stimulus (requiring more interpretation than words or objects)—intermediary symbol—word response.

This interpretation would seem to take account of both the statistical results and the introspective reports; it is also in accord with more general discussions found in semantic literature (3).

E. SUMMARY

1. Analysis of the data in terms of the most common responses and in terms of the kind or type of responses given to 25 items presented as words, objects, and drawings indicate the processes of free association to words, objects, and drawings are similar in kind and similarly ordered. This result is further confirmed by previous work done in this laboratory in comparing the effects of words and auditory stimuli (5, 9).

2. Although qualitatively the processes are of this nature, yet quantitatively words and objects show distinctive variations in degree of response for certain types of association.

3. This difference may be described by saying that objects and pictures call forth a preponderance of dynamic or operational responses in terms of associated actions, and that words elicit a greater number of static responses in terms of associated objects. Words also elicit more clang and phrase completion responses than objects and drawings.

4. Reaction time for words is faster than for either objects or drawings; reaction time for drawings is slightly slower than for objects.

5. Pictorial stimuli tend to be intermediate between words and objects

but more closely approach the characteristics of the object level of stimulation.

6. The most probable interpretation of the difference in reaction time for words, objects, and drawings is offered in the text.

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