

INSTITUTE FOR THE  
STUDY OF  
INTELLECTUAL  
BEHAVIOR

Definition and Measurement of Three Processes of Imagery  
Representation: Exploratory Studies of Verbally Stimulated Imagery

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Program on Cognitive Factors in Human Learning and Memory Report No. 72

Institute for the Study of Intellectual Behavior

University of Colorado

Boulder, Colorado 80309

November, 1977

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ABSTRACT

Three sets of experiments lend support to the hypothesis that there are at least three processes of imagery: (1) figural, in which a quasi-visual or other sensory representation of an object is made; (2) symbolic, in which an abstract concept is illustrated or symbolized by some imaginal representation; and (3) mimetic, in which a human experience is given a complex imaginal representation involving both envisionment and enactment or miming.

Two types of scales for measuring stylistic differences in these three processes are presented in detail. One type of scale is drawn from subjects' ratings of the ease and speed with which mental images aroused by concrete, abstract, or personal words respectively. The other type of scale is drawn from subjects' ratings of the vividness of images aroused by various phrases specifically written to tap one or other of the hypothesized imagery processes.

Two experiments are described in which the three processes are differentially activated by instructions as well as by type of stimulus material. In both experiments the expected interaction effects (between instructions and type of material) are found with  $p < .001$ .

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In recent years several authors have proposed that cognitive representations occur in two or more modalities. Paivio (1971) has argued that verbal and imaginal modalities may be employed separately; and that if both are employed for a given item of information (the dual-coding hypothesis) then learning and retention are markedly improved. Horowitz (1970), following Bruner (1964), has argued for three modes of representation, namely lexical (verbal), imaginal (mainly visual images), and enactive (motoric representation in gesture etc.). The present series of studies has focused chiefly upon the imaginal mode; however, it is proposed that different processes of representation occur within the imaginal mode.

Indications in the literature (Richardson, 1968; Bower, 1972) suggest that some images are memories of scenes once perceived, while others are constructions unlike anything perceived. In one series of experiments, Bower had subjects do paired-associate learning by producing an interactive scene image embracing the two objects referred to by a pair of words. In Bower's model the imagery and verbal systems are so interconnected that the separate words and their associated images are both involved in the production of a composite DOG-ON-BICYCLE, and the output may be either imaginal (a drawing) or verbal (a statement). Thus images referring to remembered objects (dog, bicycle) and also images illustrating a novel relationship (riding on) enter Bower's conceptualization.

All of Bower's experiments have used highly concrete words like DOG, COTTAGE, etc. Paivio (1971, p. 63) reports that instructions to use imagery aid learning even when the stimuli are abstract words like JUSTICE. In this case, no concrete, sensory referent is denoted by the word, but a referent may be used to illustrate the concept suggested by the word. Paivio has also reported (Paivio, et al. 1968) that some words which are abstract (low in rated concreteness) receive high imagery ratings. These words seem to refer to personal experiences such as attitudes and emotions: for example, PANIC, GRIEF. Although like the abstract

words in terms of low sensory reference, these words are like concrete words in evoking imagery. In the present conceptualization, these anomalous words are thought to involve a different kind of imagery process. We shall refer to this process as mimetic.

In summary, the literature suggests that, within the imagery mode three different processes can arise. One has a figural (memory-based, quasi-perceptual) relationship to the object referred to by a stimulus word; another has a symbolic (illustrative) relationship to a concept referred to by a stimulus word; a third has a mimetic (enacting) relationship to human behavior and experience referred to by a stimulus word. In this paper we shall be giving evidence for the existence and independence of these three forms of imagery processes. This evidence will not pertain to ability in the sense of performance measured against a criterion of difficulty or time. Instead, it will be evidence from tendencies in cognitive stylistic variables.

Direct empirical support for the hypothesis of three imagery processes has been obtained from two kinds of data. In the first subjects are asked to rate words on a seven-point scale from low imagery to high imagery, according to the ease and speed with which a word evokes a mental image; the subject is thus focused outward upon the word stimulus. The second kind of data goes more directly to the subject's own imagery and requests a report of the vividness of images experienced in response to various words and phrases. In 3 sets of factor analytic and manipulative experiments we have sought to establish the imagery processes, measure them, and provide construct validation. The 3 sets of experiments employed 3 different subject samples in 3 successive years. All samples consisted of both male and female subjects.

### Experiment Set 1

Subjects. Sixty-two subjects drawn from the University of Colorado Introductory Psychology classes completed the experiment. The experiment was self-administered and self-paced as subjects worked in either one of three group sessions or individually.

Materials. Each subject received a booklet containing four rating forms and four separate answer sheets. Rating Form A was made up of 60 words drawn from the set studied by Toggia and Battig et al. (1978), the most recent and comprehensive list of semantic word norms. The instructions were the same as those of Toggia, Battig et al.

Words differ in their capacity to arouse mental images of things or events. Some words arouse a sensory experience, such as a mental picture or sound, very quickly and easily, whereas other words may do so only with difficulty (i.e., after a long delay) or not at all. The purpose of this experiment is to rate a list of 60 words as to the ease or difficulty with which they arouse mental images. Any word which, in your estimation, arouses a mental image (i.e., a mental picture or sound, or other sensory experience) very quickly and easily should be given a high imagery rating (at the upper end of the numerical scale). Any word that arouses a mental image with difficulty or not at all should be given a low imagery rating (at the lower end of the numerical scale).

For example, think of the word 'BUFFALO.' Buffalo would probably arouse an image (e.g., of Ralphie) relatively easily and would be rated as high imagery. Now think of the word 'RELEVANT.' Relevant would probably arouse an image with great difficulty and would be rated as low imagery. (Since words tend to make you think of other words as associates, it is important that your ratings not be based on associations, but rather the

ease of getting a mental image referred to by the word.)

Your ratings will be made using a seven point scale, where 1 will be used to represent great difficulty in arousing a mental image and 7 will be used to represent great ease in arousing a mental image. The scale value 4 would then be used to represent the rating of a word falling between these two extremes. Try not to rate all words at the extremes of the scale, but do rate the words according to your judgment.

The 60 words used in Rating Form A had a Thorndike-Lorge frequency of between 10 and 49 per million. There were nouns, adjectives and verbs, which varied in mean-rated concreteness (on a scale from 1-7 similar to the scale for imagery) from 2.41 (FUNCTIONAL) to 6.34 (SKIN) and covered a wide range of subject matters.

Form B was a brief personality questionnaire the purpose of which was not related to studies in imagery. Form C was the Sheehan test (Sheehan, 1967) for vividness of imagery. This test measures general vividness of reported imagery to a variety of scenes involving several sensory modalities: a person walking; the honk of an automobile horn; smelling roast beef.

Analysis. Principal axis factor analysis was employed using programs developed by David Saunders (1962). The analysis is iterated until communalities converge. An equamax orthogonal rotation (Saunders, 1962) followed this analysis. Because of the sample size, items were studied in 2 sets of 30 each, odd and even.

Results. The total converged communality was 12.88 for the odd items and 12.19 for the even. In each case, this value was not exhausted until six factors were accounted for. In the odd set the eigen values were 6.17, 4.81, 1.90, 1.01, 0.75, and 0.74; in the even set, eigen values were 6.28, 4.71, 1.19, 0.97, 0.78, and 0.74. In both sets one factor had all concrete words (e.g. TUNNEL), one had all abstract words (e.g., UNIVERSAL), and one had all personal words (e.g. NERVOUS)

with loadings above .040. The remaining three factors in each set had words of mixed kinds and were not readily interpretable (see Cartwright and Durrett, 1975).

It was decided to work further with the 3 readily interpretable factors at this time. For clarification of these factors, representative words from both the odd and even sets were pooled and refactored with a limit of three factors to be rotated in keeping with the 3 process hypothesis. The results are shown in Table 1 with the independently obtained mean ratings of concreteness and imagery for each word. It can readily be seen that Factors 1, 2, and 3 correspond to three sets of words differing in patterns of mean concreteness and imagery ratings on the Colorado norms (Toglia, Battig *et al.*, 1978). The meanings of the words within the three sets appear to justify labeling them (and the corresponding factors) as concrete (C), abstract (A), and personal (P). Simple-sum factor scores showed the following correlations:  $r_{ca} = -.11$ ;  $r_{cp} = .28$ ;  $r_{ap} = .35$  ( $df = 60$ ,  $r \geq .25$ ,  $p < .05$ ). Differences among the three groups reached significance for the personal word scores ( $C_p < .05$ ); only slight differences emerged for the concrete and abstract word scores. Figure 1 illustrates these results.

Discussion. It is apparent that ratings of imagery involve a number of processes and that three of these rating factors relate to particular kinds of words: concrete, abstract, and personal. It was hypothesized at this time that individual differences on these factors are produced by different tendencies to employ three processes of imagery, namely, figural; symbolic; and mimetic. In the following set of experiments, this hypothesis was tested more directly, and an effort made to modify the Sheehan test to more accurately assess the three processes of imagery.

## Experiment Set 2

Subjects. One hundred and six subjects were obtained from the Introductory psychology classes.

Materials. Printed instruction sheets, a list of words for rating imagery, and mark-sense recording sheets were provided. The words were selected from Toglia, Battig et al., (1978) and had a Thorndike-Lorge frequency between 10 and 49 per million. Fifteen items were carried over from the previous study as markers. Instructions for rating Form 'A' were identical to those of Experiment 1. Form 'B' was the first modified version of the Sheehan test.

Analysis. The methods of factor analysis used in Experiment 1 were followed here for both the rating and the vividness data.

Results. The ratings of imagery yielded seven factors each for both the odd and the even items. Two factors in each set (odd and even) had only concrete words with loadings above .40. Both sets contained one factor with abstract words only. One set had two factors with personal words and the other had one such factor. Remaining factors were not clearly interpretable. Setting aside for the moment the complexity of two concrete factors, the pooling procedure and subsequent factoring of the items to best represent the three imagery processes (aroused by the C, A and P words) yielded the results shown in Table 2 (complete details are given by Cartwright and Marks, 1975). Once again it is apparent that factors 1, 2, and 3 correspond to three sets of words having different patterns of mean concreteness and imagery ratings on the Colorado norms.

Factoring of the modified vividness test produced unclear results which were subsequently used to provide suggestions for writing new items. Results with the latest revision will be presented below.

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### A Manipulative Experiment

It was expected that the three processes of imagery could be differentially aroused by special instructions; under instructions for symbolic imagery the ratings of ease and speed of imagery for abstract words should increase, and likewise for personal words under instructions for mimetic imagery.

Subjects. 102 of the above subjects also participated in this manipulation. They were randomly divided into 3 groups of 34 each.

Materials. Printed instruction sheets, a list of words for rating imagery, and mark-sense recording sheets were provided. Instructions for Group 1 were the same as those in Experiment Set 1. It was assumed these instructions arouse figural imagery whenever possible.

Group 2 received instructions that were structurally like those given to Group 1 but designed to evoke symbolic imagery. Two changes in particular should be noted. The first part of the instructions for this group read:

Words differ in their capacity to arouse mental images which stand for, symbolize, or illustrate the idea they refer to. Some words arouse an image, such as a symbol or illustration, very quickly and easily, whereas other words may do so only with difficulty (i.e., after a long delay) or not at all.

The second change occurs in paragraph two; it begins:

For example, think of the word 'PEACE'. Peace would probably arouse an image (e.g., of a dove, or a quiet country scene with occasional bird-song, or an old man smoking a pipe) relatively easily and would be rated as high imagery.

The mimetic imagery process was emphasized in Group 3. The first instructional



paragraph for this group read:

Words differ in their capacity to arouse mental images of feelings or emotions. Such words arouse an imagined experience, such as a mental attitude or feeling, very quickly and easily, whereas other words may do so only with difficulty (i.e., after a long delay) or not at all.

Likewise, the beginning of the second paragraph was altered to read:

For example, think of the word 'SORROW.' Sorrow would probably arouse an image (e.g., of crying or sad feelings) relatively easily and would be rated as high imagery.

The remaining portions of the instructions for Groups 2 and 3 were similar to those of Group 1. Only minor changes in vocabulary were made in keeping with the imagery process being described.<sup>1</sup>

Analysis. It was important to obtain highly reliable scores of C, A, and P factors for this manipulation. Accordingly, the data of the first part of Experiment Set 2 were subjected to item-analysis. Three reliable scales were constructed, each consisting of 8 items. The alpha-reliability values of these scales are given separately for the three instruction groups in Table 3. These values are within conventional standards of acceptability for reliability scores.

Analysis of variance for a 3 X 3 factorial design with one between and one within treatment was carried out. The prediction of a significant interaction between instructional set and imagery ratings of the concrete, abstract and personal words is supported as shown in Table 4.

<sup>1</sup>Complete copies of the three instructional sets can be obtained by writing:  
Prof. D. Cartwright/Department of Psychology/University of Colorado/Boulder,  
Colorado 80309.

However, the detailed picture of that effect is not exactly as predicted. Table 5 shows the mean scores for the three word types by the three instructional groups. It can be seen that the absolutely highest mean for the abstract words was obtained under mimetic instructions and for the personal words under the symbolic instructions. This suggested a defect in the instructions, possibly the inadvertent use of 'RELEVANT' as the low imagery example in both symbolic and mimetic instructions. Remedies for this were sought in the next set of experiments.

Discussion. The experiments in set 2 have supported the hypothesis that at least three processes in word imagery ratings exist and that their natures can be approximately designated as concrete, abstract, and personal. The evidence also supports the hypothesis that some imagery processes are non-referential in nature (i.e., symbolic or mimetic) and can be brought into operation to some extent by manipulation of instructions. The mean scores on concrete words are decreased by figural and mimetic instructions, while the means for abstract and personal words are increased. It is noteworthy that word type continues to exert a powerful effect in rated imagery so far as the contrast between concrete and abstract is concerned. Compared with personal words, however, the usual superiority of concrete words is all but abolished by mimetic instructions.

### Experiment Set 3

This set of experiments was designed to consolidate and improve the precision of the earlier results. In addition it was hoped that reliable scales for both word imagery and vividness ratings could be produced for the use of other investigators.

#### Consolidation of Rating Data

In this experiment all of the factorially purest items in the previous two sets of studies were brought together along with a few new items specifically

designed to measure a particular factor (e.g. LAUGHING to measure the personal factor). Instructions were also modified for greater precision.

Subjects. A sample of 108 undergraduates participated in the experiment as part of their course requirements.

Materials. The booklets provided to subjects were similar to those before. However, now each word stimulus in Form 'A' was preceded by a letter indicating its intended part of speech, for example, "n, ANGER." As before, 60 words were rated. The instructions were as follows:

Words differ in their capacity to arouse a mental image which pictures the thing, event, or idea referred to by the word. Some words arouse a sensory experience, such as a mental picture or sound very easily, whereas other words may do so only with difficulty or not at all. The purpose of the experiment is to rate each of 60 words as to the ease or difficulty with which it arouses a mental image. Any word which, in your own experience, arouses a mental image (i.e., a mental picture, sound, or other sensory experience) very easily should be given a high imagery rating (at the upper end of the numerical scale). Any word that arouses a mental image with difficulty or not at all should be given a low imagery rating (at the lower end of the numerical scale).

For example, think of the word 'COTTAGE.' It might arouse a mental picture of an actual cottage.

If a word is to be interpreted as a noun, it will have an n in front of it; if as an adjective, it will have an a in front; if a verb, it will have a v in front; if an adverb, it will have adv in front.

Remember that the mental image must picture the thing, event or idea referred to be the word.

(Other portions of instructions as before)

Analysis. A preliminary cluster analysis (CC5 - CSA1) on the BCTRY system (Tryon and Bailey, 1970) was used for item-analysis. This analysis was preset at three variables in keeping with the findings of Experiment 1. The program SCALESCORE (Scott, 1972) provided the final scale scores and related statistics.

Results. Three 14-item scales were established. These are shown in Table 6. Alpha-reliabilities seemed quite acceptable in all cases:  $\alpha_c = .91$ ;  $\alpha_a = .84$ ;  $\alpha_p = .86$ . The pattern of intercorrelations essentially replicates that found in the previous studies, with  $r_{ca} = -.12$ ,  $r_{cp} = +.31$ , and  $r_{ap} = .36$ .

#### Experiment Manipulating Instructions<sup>2</sup>

Subjects. Thirty-six undergraduate subjects were randomly assigned to one of three instruction groups. Twelve of these were included in the 108 subjects in the previous section.

Materials. The figural instruction group received the instructions shown in the preceding section. The symbolic instruction group received the following instructions:

Words differ in their capacity to arouse a mental image which stands for, symbolizes, or illustrates the thing, event, or idea referred to by the word. Some words arouse an image, such as a symbol or an illustration very easily, whereas other words may do so only with difficulty or not at all...

For example, think of the word 'THEORETICAL.' It might arouse a

<sup>2</sup>The assistance of Frances Costa in serving as experimenter for this study is gratefully acknowledged.

mental picture of a physicist working at his desk trying to solve some equations...

Remember that the mental image must stand for, symbolize, or illustrate the thing, event or idea referred to by the word. (Other portions of instructions as for figural group, Experiment 3).

The mimetic instruction group received the following instructions:

Words differ in their capacity to arouse mental images of personal attitudes, feelings, behavior, or physiological reaction. Some words arouse an imagined experience, such as a feeling or behavior, very easily, whereas other words may do so only with difficulty or not at all...

For example, think of the word 'JOY.' It might arouse a mental image of a baseball batter shouting hooray and leaping with happiness at having hit a game-winning home run. Or it might arouse an image of yourself feeling great and singing joyfully...

Remember that the mental image must be an imagined experience such as personal attitude, feeling, behavior, or physiological reaction. It might be an imagined experience of seeing and hearing another person's feelings and behavior etc.; or it might be an imagined experience of your own attitude, feeling, behavior, etc.

(All other portions of instructions as for figural group, Experiment 3).

All groups received the same set of 60 words to rate for ease of imagery. The words were identical with those given in the previous experiment of this set.

Analysis. The scale scores in Table 6 were calculated for each subject. Reliabilities were .92, .81, and .87 for C, A, and P scales, respectively, and are comparable to those shown in Table 6.

Table 7 summarizes the analysis of variance. Means for these data appear

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in Table 8. It should be noted that 14-item scales are reflected in the means of Table 8 as contrasted with 8-item scales in the means of Table 5. Again a significant interaction occurs between instructional set and word type. Symbolic instructions raised the abstract word imagery mean rating and mimetic instructions raised the personal word imagery mean rating. These results are summarized in Table 8. However, the symbolic instructions appear to have also raised the mean imagery rating for both concrete and personal words. Of course, the instructions apply to all words in the list; this suggests that the symbolic form of imagery can work just as well on concrete and personal words as on abstract (compare the significant between-groups effect in Table 7). The data also suggest that mimetic instructions raise the mean rating for abstract words as well as personal (as did the mimetic instructions in Experiment Set 2; data shown in Table 5). Once again it seems likely that the mimetic process of imagery can be used to make representations of the meanings of abstract words. In contrast, Table 8 suggests (as did Table 5) that the set to use mimetic imagery reduces the mean rating for the concrete words.

#### Refinement of Measures for Vividness

Subjects. Of the 132 subjects participating in Experiment Set 3, 120 also completed the imagery vividness forms.

Materials. Subjects were given booklets as before. Form 'B' now had the following instructions.

The aim of this experiment is to determine the vividness of the images which different words and phrases evoke. The items of the booklet will bring certain images to your mind. Please rate the vividness of each image by reference to the accompanying rating scale, which is shown below. For example, 'A WINDY NIGHT' might arouse an image which is moderate in vividness.

You would rate it "4". Or suppose the image aroused by 'A BUNCH OF BANANAS' is high in vividness, with shape, color, and detail almost as if you were looking at the bananas, you would mark "7" on your coding sheet.

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The Rating Scale

1	2	3	4	5	6	7
LOWEST			MODERATE			HIGHEST
VIVIDNESS:			VIVIDNESS:			VIVIDNESS:
A very vague image			Image is almost like			
almost like nothing at all			a real experience			

Throughout the experiment refer to the rating scale above when judging the vividness of each image. A copy of the rating scale will be provided on the following pages for your use in rating the items.

Please complete all items on a given page before turning to the next page of items. Do not turn back and check on the other items which you have done. Do each item separately without reference to any previously rated items.

The first page of items contained instructions and items for figural (fig) imagery. Instructions and typical items were as follows:

Let each of the following items bring an image to your mind. Consider it carefully and rate the vividness of the image using the rating scale below:

- A HIGH SHELF
  - A TELEPHONE RINGING
  - THE FEEL OF FUR
-

The second page followed with instructions and items for mimetic (mim) imagery.

Think of someone you know, and consider carefully the image that comes to your mind for each of the following items. Please rate the vividness of the image an item evokes, using the rating scale below:

THEIR BEHAVIOR WHEN HAPPY

HOW THEY FEEL WHEN THEY ARE PROUD OF SOMETHING

The third page presented instructions and items for symbolic (sym) imagery as follows:

Think of the following matters that affect citizens, and consider carefully the image that comes to your mind. Please rate the vividness of the image an item evokes, using the rating scale below:

ENVIRONMENTAL PROTECTION

THE PUBLIC INTEREST

INTERNATIONAL LAW

The fourth page had instructions and items for imaging the self. It was expected that this pilot scale would correlate highly with the mimetic scale, since a central hypothesized component of mimetic imagery involves enactment (representing the information in one's own body actions and feelings):

Think of yourself and consider carefully the image that comes to your mind for each of the following items. Please rate the vividness of the image an item evokes, using the rating scale below:

WAKING UP IN THE MORNING

FIXING YOUR HAIR

FEELING PROUD WHEN YOU GET AN A

Analysis. Item analyses and scale scoring were carried out as for the rating data.



Results. Twelve-item scales for figural, symbolic, and mimetic imagery vividness were established as shown in Table 9. Alpha-reliabilities ranged between .75 and .80. Intercorrelations closely paralleled those for the rating data:  $r_{\text{fig-sym}} = .00$ ,  $r_{\text{fig-mim}} = .30$ ,  $r_{\text{sym-mim}} = .19$ .

Table 10 shows the cross correlations between rating scales and vividness scales. These correlations should be taken as indicators of construct rather than concurrent validity since the sets of constructs being measured are not identical. Indeed the hypothesized relationship is that subjects' own figural imagery vividness tendency contributes some portion of variance to the subjects' rating of concrete words for ease and speed of imagery. Other portions of variance might derive from the subject's judgment about how easily and speedily a word evokes an image among the general population.

Table 10 shows that, as expected, significant positive correlations were found between figural and concrete, symbolic and abstract, mimetic and personal. Some unexpected relationships also occur. It seems that all three vividness scales are correlated with the personal word scale (a result consistent with those shown in Figure 1). Additionally, mimetic vividness correlates significantly ( $p < .05$ ) with the abstract word scale.

The self(s) vividness-of-imagery scale was introduced to test the hypothesis of enactment in mimetic imagery. Its correlations were  $r_{\text{s.fig}} = .47$ ,  $r_{\text{s.sym}} = .18$ ,  $r_{\text{s.mim}} = .50$ . These results are consistent with the enactment hypothesis. However, they also suggest that figural imagery is substantially involved in images of the self in action.

Discussion of Experiment Set 3. These experiments have consolidated and refined measurements of the imagery variables under study. Reliabilities are average to high for rating and self-report instruments. Moderately satisfactory

indications of construct validity have been obtained. These characteristics of the scales shown in Tables 6 and 9 appear to justify publication of the scales at this time so that other investigators may use them.

#### Summary and General Discussion

That cognitive representation occurs in more than one modality has received a great deal of support recently. In many places, the literature has also offered indications that even within one mode such as imagery different processes can be found. The results reported here offer empirical support for this general hypothesis and specify three particular processes that can be found in imagery, namely figural, symbolic and mimetic. In the figural process an image descriptively depicts the scene or object referred to by the stimulus word. In the symbolic process an image illustrates (stands for or symbolizes) the concept communicated by the stimulus word. In the mimetic process an image is constituted of the envisioning and/or enacting of a human experience or behavior suggested by the stimulus word.

From studies in which these processes were successfully evoked by instructional sets, we learned that it is hard to isolate such processes completely from each other. For example the instructions to use mimetic imagery lowered (but did not eliminate) imagery speed and ease ratings for concrete stimuli and raised the ratings for abstract stimuli as well as raising the ratings for personal stimuli.

Within the context of a general model of imagery, the three processes described and measured here may be considered as stylistic traits which nevertheless can be modified by instructions. Moreover, these traits do not appear to function equally well under all stimulus circumstances but rather are differentially facilitated by the precise type of word material serving as stimuli,

whether that be concrete, abstract, or personal. Thus a general model will have to account for individual differences in trait level, for modifications of level by instructions, and for differential facilitation of the imagery processes by different types of stimuli. It seems reasonable to suppose that the word stimuli by themselves have little power to produce the observed effects, but rather that they depend upon the subject's interpretive response. Part of this response is no doubt constrained by long-term semantic structures, such as DOG is a noun referring to a small four-footed domestic animal that barks. Another determinant of response would seem to be contextual. For example, if the immediately preceding list of words contained only verbs (such as FOLLOW, HUNT, HARRASS, SIT, FETCH) and so on) then quite likely DOG could be interpreted as a verb meaning "keep on the heels of". This suggests further that part of the interpretive process may be conceived as putting the stimulus word as a linguistic unit into a general grammatical category and also into some broad semantic category. Which of several possible categories in each class is selected would depend upon other features of context, including those of explicit instructions to the subject. These considerations suggest that the measures developed in the present set of experiments should next be used to assess stylistic differences in tests of the three-way interaction hypothesis relating word stimulus, mental set, and individual differences.

Horowitz's (1970) concepts of imaginal and enactive representations seem similar to our concepts of figural and mimetic processes respectively. However the mimetic process, as we conceive it, also includes envisagement, which is a figural component concerned with the quasi-sensory aspects of mimetic imagery; it also includes some illustrations of experiential events, which would be a symbolic component. Both of these conceptual aspects of mimetic imagery receive

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some support from the present findings of small positive correlations between mimetic imagery on one hand and both figural and symbolic imagery on the other. It may be noted that Horowitz's third kind of representation (lexical) bears no similarity to our concept of symbolic imagery because it refers strictly to verbal symbols, which are not part of symbolic imagery as we conceive it.

Like Horowitz, Paivio (1971, 1975) restricts the concept of imagery to a quasi-sensory and referential role. Paivio is quite explicit on this point: "...the verbal system (is) an abstract, logical mode of thinking as compared to the concrete, analogical mode that apparently characterizes imagery" (Paivio, 1975, p. 148). Our data do not support this position regarding imagery. Only figural imagery fits the description of "concrete, analogical"; symbolic and mimetic imagery are not well described in this way. Furthermore the assumption that only one imagery process requires conceptualization is not supported by the results presented here. Nonspecific instructions to produce imagery may well arouse more than one imagery process. As seen in our manipulative experiments, the inadvertent elicitation of more than one imagery process can apparently occur even when the experimenter is aiming to elicit one process only and exclude all others. Less specific instructions are even more likely to elicit two or more processes. Bower's (1972) instructions for interactive imagery seem to have elicited two processes: figural (for the objects) and either mimetic or symbolic (for the interactive relationship). Even instructions to raters in normative studies such as those of Paivio et al (1968) and Toggia, Battig et al (1978) may elicit judgments drawing on more than one imagery process. Such a possibility is consistent with our initial discovery of concrete, abstract, and personal word factors in such rating data. Paivio et al (1968) found some words which, though relatively abstract, were nevertheless rated as high in

imagery. These words mostly referred to emotions or affective attitudes (Paivio, et al, 1968 p. 7). They included AFFECTION, ANGER, BRAVERY, GRIEF, JOY, LOYALTY, PANIC, SHAME, TRAGEDY, and VANITY. It seems reasonable to suppose that their higher ratings of imagery reflected the operation of either the mimetic process (for ANGER, JOY, etc.) or the symbolic process (for BRAVERY, LOYALTY, etc.).

In a recent article, Yuille and Catchpole (1977) have proposed that imagery should be placed in the context of a viable general model of cognition. They reject Paivio's dual-coding model of verbal and imaginal representations because, in their view, it cannot account for information storage and abstract processing. They consider a major alternative approach which rests upon a general assumption that human information processing is analogous to computer information processing (Newell and Simon, 1972). In this alternative, human knowledge is stored in the form of abstract propositions and is used in various cognitive procedures which resemble the functions and subroutines executed under control of a computer program (Anderson and Bower, 1974; Pylyshyn, 1973). According to Pylyshyn, the storage: "...resembles neither pictures or words and is not available to subjective experience... As long as we recognize that people can go from mental pictures to mental words and vice versa, we are forced to conclude that there must be a representation (which is more abstract and not available to conscious experience) which encompasses both" (Pylyshyn, 1973, p. 5).

Yuille and Catchpole reject this "abstract proposition" approach, saying that it too is one-sided since it addresses only storage and abstract processing. Both the representations in words and images and also the abstract storage and processing are needed. They recommend rather a third alternative approach which offers such a more inclusive model of cognition, namely the approach of Piaget and Inhelder (1971). Briefly, this approach holds that imagery is symbolic in

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the first place, and as such is used in a variety of cognitive operations, including fantasy, anticipation, and memory.

We agree with Yuille and Catchpole that it is necessary to develop more formal theory for the role of imagery processes in a general model of cognition. This would allow for an integrated formulation of the functions of imagery in memory, problem-solving, and other cognitive events. Whether imagery processes are used by other operations or whether they are themselves users of other operations remains an open question in our judgment. It is not obvious to us that conscious representations are less abstract than non-conscious processing, nor is it beyond doubt that storage of images must be in some propositional form. Positions taken on these issues seem lacking in hard evidence at the present time. Hence it may well be too early to reject any of the major existing approaches or to accept any particular form of integrative theory. A distinction is commonly made between the functions and nature of imagery (cf. Sheehan, 1972), and the search for a general model of cognition within which to conceptualize imagery is surely a search for integration of its functions. The search for deeper understanding of the nature of imagery, however, can quite well proceed in a fashion parallel to the formulation of an integrative theory of functions. It might even be considered as having priority since determining the nature of imagery is likely to specify more exactly what it is that must be integrated in a more general theory of function. The position of the present authors is that at least the three imagery processes described in this paper must be taken into consideration in a more general theory of cognition.

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Table 1

## EXPERIMENT 1: CONCRETENESS, IMAGERY, AND EQUAMAX FACTOR

LOADINGS OF 30 WORDS RATED FOR IMAGERY<sup>a</sup>

	Word	Rated Concreteness <sup>b</sup>	Rated Imagery <sup>b</sup>	Factor 1	Factor 2	Factor 3	$h^2$
CONCRETE WORDS	COTTAGE	5.97	5.93	51	00	17	29
	LEMON	5.98	6.19	56	-17	09	35
	TUNNEL	5.51	5.72	79	-06	16	65
	BELL	6.20	6.11	71	-19	12	56
	CIGAR	5.81	5.98	67	-17	20	51
	SILK	5.38	5.04	59	12	23	41
	KNIGHT	5.78	6.02	67	-02	00	43
	MARIJUANA	6.27	6.25	41	-06	06	17
	POWDER	5.13	5.17	60	06	-06	36
	SKIN	6.35	6.65	57	-07	03	33
ABSTRACT WORDS	PRIME	3.60	3.80	-09	36	31	23
	THEORETICAL	2.63	3.28	-22	79	04	68
	UNIVERSAL	3.35	3.50	-05	63	08	40
	CUSTOM	3.10	3.51	07	57	21	38
	EVOLUTION	3.00	3.97	-01	61	16	39
	FUNCTIONAL	2.41	2.82	-07	69	25	55
	LIBERTY	3.60	3.75	-21	59	16	41
	PRODUCTIVE	3.09	3.32	-06	62	13	40
	INFINITE	2.65	3.95	-06	55	05	31
	TENURE	3.41	3.20	11	76	09	60
PERSONAL WORDS	GRIEF	3.39	4.67	12	18	71	56
	IGNORE	3.16	3.94	16	22	73	60
	NERVOUS	3.32	4.79	08	14	69	50
	PINE	5.88	6.11	00	18	45	24
	QUARREL	3.75	4.73	27	04	67	53
	SHAME	3.40	3.95	22	08	68	51
	HATE	3.91	4.38	01	13	64	43
	KISS	5.90	6.23	16	03	32	13
	PANIC	3.66	4.72	-11	19	68	51
	WEAK	3.46	4.32	30	17	55	42

<sup>a</sup> Decimals omitted throughout from factor loadings

<sup>b</sup> Courtesy W. F. Battig et al. (1973)

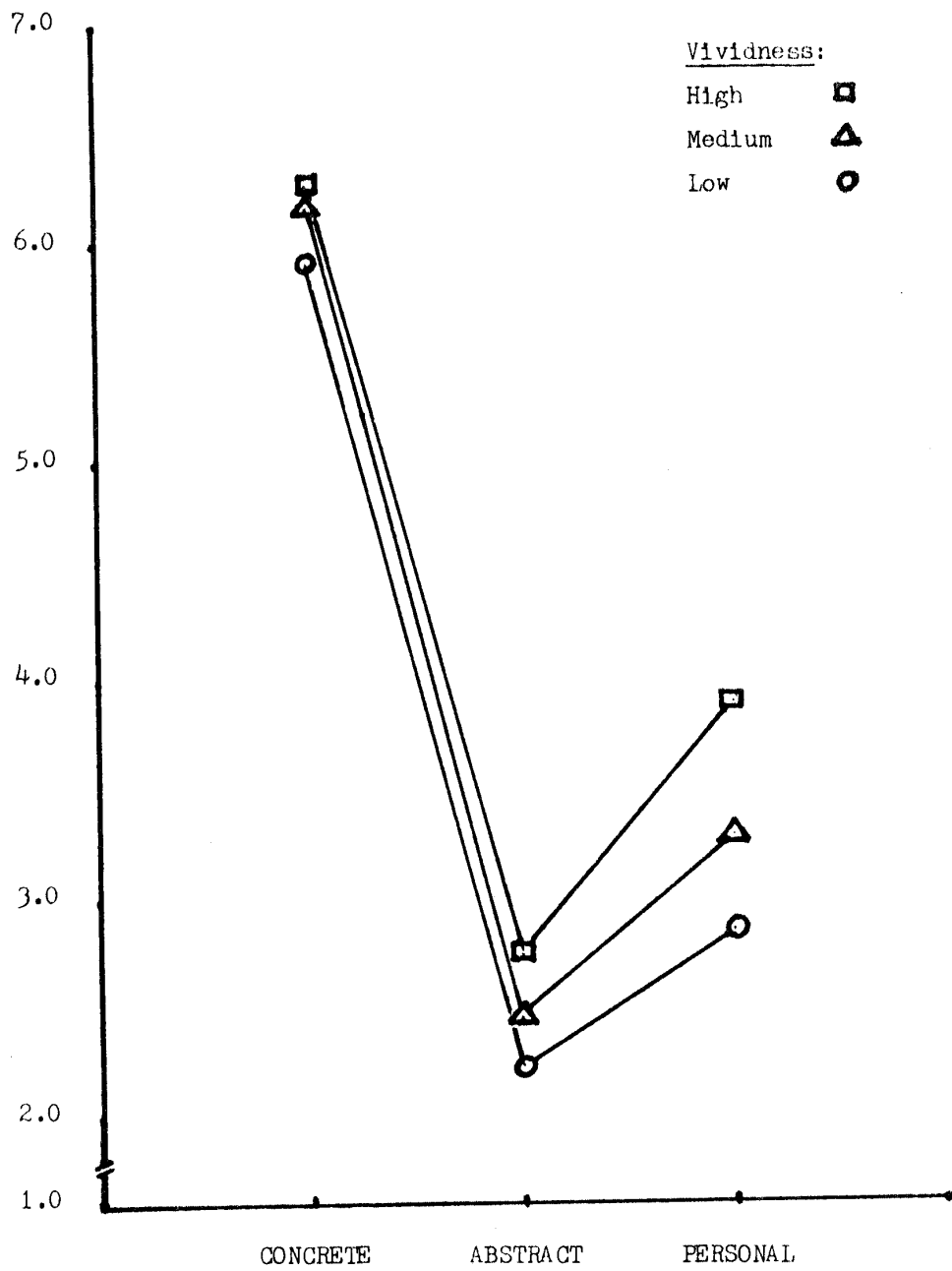


Figure 1. Average item imagery ratings for groups with high, medium and low vividness of imagery on the Sheehan test.

Concreteness, Rated Imagery, and Equamax Factor  
Loadings: 30 Words Rated for Imagery<sup>a</sup>

	<u>Word</u>	<u>c</u>	<u>Concreteness</u> <sup>b</sup>	<u>Imagery</u> <sup>b</sup>	<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor 3</u>	<u>h<sup>2</sup></u>
CONCRETE WORDS	COTTAGE	*	5.97	5.93	61	-05	06	38
	POWDER	*	5.13	5.17	67	01	05	46
	KNIGHT	*	5.78	6.02	70	05	00	50
	STRING	*	5.48	5.15	81	05	-09	67
	HOTEL	*	5.88	6.00	59	05	-09	36
	VILLAGE	*	5.70	5.32	71	-03	00	50
	SIDEWALK		5.93	5.26	68	-12	-05	48
	LANTERN		6.29	5.65	78	01	-13	63
	CELLAR	*	5.41	5.27	74	-06	05	55
	LUMBER	*	6.10	5.67	85	-01	-06	72
ABSTRACT WORDS	REPLACEMENT	*	3.52	3.41	11	53	05	29
	JUSTIFY	*	2.85	3.30	-09	56	13	34
	THEORETICAL	*	2.63	3.28	07	52	-02	28
	CUSTOM	*	3.10	3.51	03	57	14	33
	FUNCTIONAL	*	2.41	2.82	07	62	02	39
	JUSTICE		3.74	3.35	-09	55	31	41
	MOMENT	*	2.88	3.78	-05	42	28	26
	TYPICAL		2.63	3.04	-09	33	14	14
	HARDLY	*	2.21	2.54	-03	58	05	34
	OBSCURE	*	3.19	3.53	-07	54	20	33
PERSONAL WORDS	HATE		3.91	4.38	-05	20	58	38
	JOY	*	3.71	5.25	-02	13	76	59
	ANGER	*	3.80	4.82	01	18	78	64
	PASSION	*	3.56	4.07	02	11	65	44
	LOVE	*	3.55	5.80	-10	04	55	32
	SAD	*	3.56	3.98	09	03	75	57
	QUICKLY		2.92	3.86	-02	29	61	45
	DESPAIR	*	2.91	3.68	01	05	63	40
	GUILT	*	2.98	3.75	-11	19	73	58
	PAIN	*	4.22	4.95	-02	18	63	43

<sup>a</sup> Decimals omitted throughout from factor loadings

<sup>b</sup> Courtesy of W. F. Battig *et al.* (1973)

<sup>c</sup> Items marked with asterisk were included in factor scores used in the manipulative experiment of Set 2.

Table 3

Alpha-reliability of Concrete, Abstract, and  
Personal Factor Scales for Three Groups

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<u>Instruction Groups</u>	<u>Scales</u>		
	<u>Concrete</u>	<u>Abstract</u>	<u>Personal</u>
Figural	.89	.77	.88
Symbolic	.89	.75	.82
Mimetic	.94	.72	.87

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Table 4

Summary of Analysis of Variance on Three Imagery Scales  
for Three Instruction Groups: Experiment Set 2

Source of Variation	df	SS	MS	F	P<
<u>Between Subjects</u>	<u>101</u>	<u>10025.1</u>			
Instruction Groups	2	462.9	231.5	2.4	.10
SS Within Groups	99	9256.2	96.6		
<u>Within Subjects</u>	<u>204</u>	<u>56816.7</u>			
Imagery Scales	2	39671.5	19835.7	277.3	.001
Groups X Scales	4	2980.9	745.2	10.4	.001
Scales X SS Within Groups	198	14164.3	71.5		

Table 5

Mean Scale Scores for Concrete, Abstract, and Personal  
Words by Three Instruction Groups: Experiment Set 2

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<u>Instruction Groups</u>	<u>Scales</u>		
	<u>Concrete</u>	<u>Abstract</u>	<u>Personal</u>
Figural	49.4	15.5	32.6
Symbolic	46.9	18.5	40.9
Mimetic	41.2	22.2	40.4

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Table 6

Scales for Individual Differences in Rating the Ease and Speed of Imagery  
to Three Different Types of Words, Concrete, Abstract, and Personal

<u>Scale</u>	<u>Word</u>	<u>Mean</u>	<u>Sigma</u>	<u>Item-total Correlation (or Alpha-reliability)</u>
<u>CONCRETE</u>	n. COTTAGE	5.4	1.6	.55
	n. FURNITURE	5.2	1.7	.47
	n. CIGAR	5.7	1.7	.60
	n. LANTERN	5.6	1.7	.66
	n. ROPE	5.8	1.6	.73
	n. BELL	6.1	1.5	.59
	n. SIDEWALK	5.8	1.8	.69
	n. VEGETABLES	6.1	1.4	.62
	n. VILLAGE	5.5	1.7	.66
	n. TUNNEL	6.0	1.5	.63
	n. KNIGHT	5.6	1.9	.50
	n. POWDER	5.4	1.8	.53
	n. FOG	5.9	1.6	.67
n. LEMON	6.3	1.3	.69	
<u>CONCRETE SCALE</u>		80.5	15.3	.91

Table 6  
(Continued)

<u>Scale</u>	<u>Word</u>	<u>Mean</u>	<u>Sigma</u>	<u>Item-total Correlation (or Alpha-reliability)</u>
ABSTRACT	a. PRODUCTIVE	3.3	1.5	.56
	n. MOMENT	2.3	1.7	.34
	a. TYPICAL	2.8	1.9	.50
	adv. HARDLY	2.2	1.5	.44
	n. TENURE	2.3	1.7	.46
	n. JUSTICE	3.5	1.7	.50
	v. JUSTIFY	2.9	1.7	.55
	n. CUSTOM	3.7	1.7	.42
	n. LIBERTY	3.9	1.6	.42
	a. FUNCTIONAL	3.0	1.6	.56
	a. THEORETICAL	2.7	1.7	.53
	n. EMANCIPATION	3.4	2.0	.44
	n. TRUTH	3.9	1.9	.52
	a. UNIVERSAL	3.2	1.8	.42
ABSTRACT SCALE		43.2	13.6	.84



Table 6  
(Continued)

<u>Scale</u>	<u>Word</u>	<u>Mean</u>	<u>Sigma</u>	<u>Item-total Correlation (or Alpha-reliability)</u>
PERSONAL	v. QUARREL	4.2	1.8	.54
	v. HATE	3.4	2.0	.49
	n. GRIEF	3.6	1.7	.42
	n. DESPAIR	3.5	1.8	.44
	a. NERVOUS	4.5	1.6	.50
	v. PANIC	4.7	1.8	.49
	v. LAUGHING	5.9	1.4	.59
	n. PAIN	5.2	1.6	.62
	v. EATING	5.9	1.4	.50
	n. ANGER	5.0	1.6	.55
	v. DEFEAT	4.5	1.8	.49
	a. WEAK	4.5	1.6	.54
	n. JOY	5.4	1.5	.55
	n. HAPPINESS	5.3	1.6	.54
PERSONAL SCALE		65.4	13.9	.86

Table 7

Summary of Analysis of Variance on Three Imagery Scales  
for Three Instruction Groups

Source of Variation	df	SS	MS	F	P<
<u>Between Subjects</u>	<u>35</u>	<u>10852.4</u>			
Instruction Groups	2	3074.7	1537.4	6.52	.01
SS Within Groups	33	7777.7	235.7		
<u>Within Subjects</u>	<u>72</u>	<u>37805.3</u>			
Imagery Scales	2	26232.9	13116.5	112.8	.001
Groups X Scales	4	3897.6	974.4	8.4	.001
Scales X SS Within Groups	66	7674.8	116.3		

Table 8

Mean Scale Scores for Concrete, Abstract, and Personal  
Words by Three Instruction Groups: Experiment Set 3

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<u>Instruction Groups</u>	SCALES		
	<u>CONCRETE</u>	<u>ABSTRACT</u>	<u>PERSONAL</u>
FIGURAL	76.4	33.8	54.9
SYMBOLIC	89.8	45.8	68.8
MIMETIC	67.2	42.2	76.9

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Table 9

Scales for Individual Differences in Reported Vividness of Three Forms of Imagery: Figural, Symbolic and Mimetic

Scale	Item	Mean	Sigma	Item-Total Correlation (or Alpha-Reliability)
<u>Figural</u>	A HIGH SHELF	4.4	1.7	.24
	A CIRCLE DRAWN ON PAPER	5.2	1.8	.36
	THE SOUND OF WATER RUNNING FROM A TAP	5.1	1.5	.29
	THE HONK OF AN AUTOMOBILE	5.4	1.3	.38
	A TELEPHONE RINGING	5.8	1.3	.30
	THE TASTE OF ROAST BEEF	4.3	1.8	.45
	THE TASTE OF PEANUT BUTTER	4.6	1.8	.42
	THE TASTE OF JELLY	4.2	1.8	.54
	THE FEEL OF A WOOL SWEATER	4.8	1.8	.39
	THE FEEL OF FUR	5.2	1.6	.46
	THE SMELL OF A ROSE	4.9	1.9	.36
	THE SMELL OF GASOLINE FUMES	5.1	1.7	.43
Figural Scale		59.0	10.3	.75

Table 9  
(Continued)

Scale	Item	Mean	Sigma	Item-Total Correlation (or Alpha-Reliability)
<u>Mimetic</u>	THEIR CHARACTERISTIC WAY OF SITTING DOWN IN A CHAIR	4.2	2.0	.46
	THE WAY THE PERSON WALKS	5.4	1.6	.51
	THE PERSON'S BEHAVIOR WHEN ANGRY	5.5	1.6	.45
	THEIR BEHAVIOR WHEN HAPPY	6.2	1.2	.47
	THE WAY THEY ARE WHEN DIS- APPOINTED	4.7	1.6	.52
	WHEN THE PERSON IS BUSY	4.8	1.7	.47
	THE WAY THEY ARE WHEN IRRITATED	5.3	1.5	.35
	THEIR BEHAVIOR WHEN SAD	4.5	1.9	.42
	THEIR FEELINGS WHEN ANXIOUS	4.7	1.7	.39
	HOW THEY FEEL WHEN THEY ARE PROUD OF SOMETHING	5.6	1.6	.44
	HOW THEY FEEL WHEN HAVING A REAL GOOD TIME	6.1	1.2	.43
	HOW THEY FEEL WHEN THEY'RE REALLY TIRED	5.4	1.7	.40
Mimetic Scale		62.3	10.8	.80

Table 9  
(Continued)

Scale	Item	Mean	Sigma	Item-Total Correlation (or Alpha-Reliability)
<u>Symbolic</u>	ENVIRONMENTAL PROTECTION	4.6	1.8	.38
	FREEDOM OF THE PRESS	4.4	1.7	.45
	THE PUBLIC INTEREST	3.4	1.8	.33
	CIVIL LIBERTIES	3.6	1.8	.47
	SOCIAL REFORM	3.7	1.7	.44
	THE NATIONAL DEBT	3.9	1.8	.42
	NATIONAL PROSPERITY	4.1	1.8	.41
	FOREIGN POLICY	4.4	1.8	.52
	POWER POLITICS	3.8	1.9	.43
	INTERNATIONAL LAW	3.1	1.6	.49
	INTERNATIONAL COOPERATION	3.9	1.7	.57
	WORLD PEACE	4.9	2.0	.52
Symbolic Scale		47.8	12.0	.80

Table 10

Cross Correlations Between Concrete, Abstract and Personal Scales, and Figural,  
Symbolic, and Mimetic Scales<sup>a</sup>

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<u>Scales</u>	<u>SCALES</u>		
	<u>CONCRETE</u>	<u>ABSTRACT</u>	<u>PERSONAL</u>
FIGURAL	.40	.12	.22
SYMBOLIC	.02	.28	.35
MIMETIC	.14	.21	.33

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<sup>a</sup>For  $df = 95$ ,  $r \geq .21$ ,  $p < .05$ ;  $r \geq .27$ ,  $p < .01$