Memory & Cognition
1974, Vol. 2, No. 2, 385-390

Enactive imagery in paired-associate learning

MARCIA Z. LIPPMAN*
Western Washington State College, Bellingham, Washington 98225

Three experiments were conducted to study the effects of enactive imagery (EI) on associative learning. In Experiment I, groups of Ss rated 226 verbs on EI and frequency. In Experiments II and III, Ss learned a 24- and a 16-item list, respectively. The lists consisted of the four possible stimulus-response combinations of high (H) and low (L) EI verb pairs: H-H, H-L, L-H, L-L. In both experiments, EI was found to be a significant factor on the stimulus side, performance being superior when the stimulus was of high EI. In Experiment III, the response EI main effect and the Stimulus by Response EI interaction were also found to be significant. The results indicated that like the imagery evoked by nouns, the EI evoked by verbs facilitates learning.

The effect of noun imagery on paired-associate learning has been investigated in a series of recent experiments reviewed by Paivio (1969, 1970). In general, it has been found that learning is facilitated when the noun is concrete, especially when it is on the stimulus side. Paivio has suggested that imagery on the stimulus side facilitates learning because imagery makes the stimulus an effective peg to which the response can be attached. It is assumed that the image serves a mediating function. On test trials when only the stimulus word is presented, the elicited image serves as an additional cue for the response word and may also reinstate compound images that were formed between the stimulus and response component during learning.

Although imagery has sometimes been defined in a fairly broad way by most researchers, actual materials have been biased almost exclusively toward eliciting imagery of a visual nature, i.e., a memory of previous visual experiences. It was the purpose of the present studies to attempt to elicit and study the effects of imagery based on a different form of sensory experience, action. The work of Piaget and Inhelder (1966) and Bruner, Olver, and Greenfield (1966) suggests that a primitive mode of representation is in the form of memory for the actions engaged in while interacting with the environment. This form of representation has been called enactive. Adults do not lose their ability to form and utilize visual imagery with the advent of symbolic, verbal forms of representation. It is likely that they also do not lose the ability to represent their activity experiences.

To determine if enactive imagery (EI) has facilitating effects similar to those found with nouns in paired-associate learning, a list of verbs was rated and a learning task constructed. It was expected that like concrete nouns, verbs having high EI values would facilitate associative learning, especially on the stimulus side.

*The author wishes to thank Carol Hutchinson and Virginia Knarr for their help in data collection, Sandra S. Smiley for providing Ss, and Holly Hartwell and Marion Yanagamachi for preparation of the manuscript.

EXPERIMENT I

Method

Enactive Imagery Ratings. A list of 226 verbs was selected for rating by systematic search in popular literature. Ratings of enactive imagery were obtained using a 7-point scale, anchored by *high* and *low*. These descriptive labels for the extremes of the scale were made on the basis of the Paivio, Yuille, and Madigan report (1968) that there is less variability and a greater range of I scores with the high-low labels than with the difficult-easy labels.

Items were presented in a 10-page booklet. Ss followed along on their copy of the instructions while E read them aloud. Enactive imagery rating instructions were adapted from those presented by Paivio et al (1968) for the ratings of nouns. The instructions were as follows:

"Verbs differ in their capacity to arouse mental representations of activity or action. Some verbs arouse a sensory experience such as a mental image or sensation of movement, very quickly and easily, whereas others may do so with difficulty (i.e., after a long delay) or not at all. *The purpose of this experiment is to rate a list of verbs as to the ease or difficulty with which they arouse the sensation of movement or action.* A word which arouses, in your estimation, a sensory experience very quickly and easily should be given a high imagery rating; a word that arouses a sensory experience with difficulty or not at all should be given a low imagery rating. For example, the word *climb* is probably more likely to arouse imagery easily than a word such as *make* or *be*. Your ratings will be made on a 7-point scale, where 7 is the high imagery end of the scale and 1 is the low imagery end of the scale. Make your rating by writing the number from 1 to 7 that best indicates your judgment of the ease or difficulty with which the verb arouses a sensory experience such as a sensation of movement. Write in the blank to the left of the word. The verbs that arouse sensory images most readily for you should be given a rating of 7; verbs that arouse images with difficulty or not at all should be given a rating of 1; verbs of intermediate difficulty or ease in evoking sensory images should be rated between the two extremes. Feel free to use the entire range of numbers, from 1 to 7; at the same time, don't be concerned about how often you use a particular number as long as it is your true judgment. Since verbs tend to make you think of other words as associates, e.g., *play* makes you think of *work* or *toy*, it is important that you note only the ease of getting a mental image or sensory experience for the verb to be rated."

The ratings for EI were obtained in groups of 15-45 students. A total of 85 Ss rated the 226 verbs. The Ss were obtained from introductory psychology and child development classes. Participation in this particular experiment was voluntary. Most Ss did, however, do so to meet a minimum requirement with regard to experiment participation or for extra credit points.

Frequency Ratings. The list of verbs was rated by a different group of 30 Ss for frequency of occurrence. The rating procedure described by Noble (1953) was employed. The instructions to the Ss were as follows:

"This is a booklet containing a list of verbs. We would like to find out how often you have come into contact with certain verbs, by having you rate each one as to the *number of times you have experienced it.* That means how often you have *seen* or *heard* or *used* the word in speech or writing.

Your ratings will be made on a 7-point scale where 7 indicates that you have encountered the word very often and 1 indicates that you have never encountered the word. A rating near 7 would indicate that you have encountered the word often; a rating near 1 that you rarely encounter the word. A rating of 4 would indicate that you have encountered the word sometimes.

"Make your rating by writing the number from 1 to 7 that best indicates your judgment of the frequency of your experiences with the verb. Feel free to use the entire range of numbers from 1 to 7; at the same time, don't be concerned about how often you use a particular number as long as it is your true judgment. Even if you don't know what a word means, rate it in terms of how frequently you have encountered it."

Results

The means and standard deviations on enactive imagery and frequency (f) ratings are presented for each verb in Table 1.

Table 1
Mean Ratings and Standard Deviations on EI and f

	EI		f	
Verb	Mean	SD	Mean	SD
Admire	3.79	2.04	4.93	1.24
Advise	3.21	1.93	4.77	1.38
Attach	3.71	1.72	4.67	1.25
Attack	6.07	1.32	4.47	1.43
Avoid	4.02	2.15	4.70	1.19
Be	1.65	1.51	6.53	0.81
Beat	5.35	1.80	4.73	1.46
Beg	5.07	1.79	3.93	1.50
Begin	3.33	2.22	5.43	1.43
Bend	5.25	1.59	5.13	1.36
Break	6.00	1.37	4.87	1.31
Brush	5.69	1.57	5.27	1.12
Build	5.25	1.71	4.90	1.33
Call	4.64	1.74	6.03	1.17
Carve	5.52	1.84	3.33	1.62
Catch	5.32	1.71	5.10	1.14
Change	3.25	1.82	5.83	1.00
Charge	4.54	2.08	4.83	1.46
Chase	5.77	1.67	4.27	1.57
Climb	6.33	1.05	5.07	0.93
Close	4.82	1.88	5.80	1.01
Combine	3.50	1.96	4.37	1.33
Come	3.56	2.07	6.50	0.81
Compete	3.96	1.98	4.33	1.45
Conceal	3.95	1.95	3.50	1.38
Consider	2.20	1.71	5.17	1.34
Contain	2.42	1.59	4.27	1.44
Control	2.75	2.01	4.60	1.56
Cook	5.62	1.59	5.60	1.25
Crow	4.33	2.03	5.63	1.28
Cry	6.35	1.15	5.83	1.32
Cut	5.70	1.59	5.00	1.34
Delay	2.48	1.55	4.00	1.46

Table 1 Continued

	EI		f	
Verb	Mean	SD	Mean	SD
Depress	3.93	2.08	5.00	1.67
Devour	5.56	1.68	2.97	1.40
Distort	3.79	2.16	3.30	1.29
Do	2.11	1.51	6.57	0.84
Drive	5.40	1.75	5.93	0.89
Eat	5.81	1.43	6.73	0.57
Enclose	3.86	1.86	3.73	1.31
Exceed	2.89	1.77	3.43	1.50
Excel	3.39	2.08	3.67	1.37
Exhaust	3.73	2.00	4.00	1.65
Expand	4.19	2.00	3.90	1.49
Explore	6.04	1.42	4.47	1.41
Expose	4.38	2.03	4.00	1.32
Fail	4.08	2.14	5.47	1.33
Fall	6.06	1.46	5.57	1.41
Falter	3.17	2.02	2.83	1.55
Fasten	4.46	2.09	4.23	1.36
Feed	4.87	1.81	5.20	1.33
Feel	4.88	2.18	6.47	0.81
Fight	6.11	1.42	5.03	1.52
Fly	6.18	1.42	4.73	1.53
Gasp	5.60	1.56	3.27	1.39
Get	2.42	1.72	6.50	0.76
Give	4.39	1.96	6.13	1.15
Glow	5.13	1.91	3.67	1.53
Go	4.26	2.07	6.50	0.72
Grieve	4.92	2.02	3.73	1.48
Growl	5.87	1.42	3.57	1.36
Gulp	5.54	1.64	3.33	1.42
Help	4.49	2.04	6.10	0.94
Huff	3.76	2.07	2.40	1.36
Hurt	4.87	1.91	5.67	1.25
Identify	3.07	2.00	5.23	1.23
Ignore	3.82	2.13	4.73	1.55
Illustrate	4.17	2.00	4.40	1.65
Imagine	4.15	2.22	5.77	1.12
Itch	6.06	1.55	4.57	1 36
Jeer	3.89	2.05	2.27	1.21
Join	3.81	1.87	5.07	1.24
Judge	3.48	2.01	4.63	1.76
Jump	6.25	1.28	4.83	1.49
Keep	2.79	1.69	6.10	0.87
Kick	6.32	1.22	4.43	1.41
Kidnap	5.60	1.66	3.20	1.49
Kill	6.08	1.74	5.00	1.73
Kneel	5.13	1.97	4.53	1.63
Knock	5.90	1.54	5.47	1.38
Laugh	6.45	1.24	6.40	0.76
Launch	5.19	1.74	2.87	1.36
Lay	4.81	2.00	5.43	1.28
Leak	4.52	1.90	3.97	1.54
Lick	5.35	1.84	3.90	1.49
Lift	5.17	1.74	4.87	1.12
Like	3.10	1.80	6.47	1.09
Listen	4.40	1.98	6.10	0.79
Look	4.54	2.06	6.30	0.94
Make	3.15	1.95	6.20	0.79
Memorize	3.71	2.22	5.63	1.22
Mow	5.21	1.95	3.13	1.38
Murmur	4.38	1.81	2.90	1.33
Nag	4.90	1.84	3.87	1.56
Need	3.11	2.01	6.03	1.25
Neglect	2.95	1.84	4.00	1.57
Nestle	3.96	2.18	2.80	1.51
Nibble	5.26	1.77	3.33	1.56

Table 1 Continued

Verb	EI Mean	EI SD	f Mean	f SD
Notice	3.08	1.83	5.00	1.53
Nudge	5.17	1.69	3.47	1.41
Obey	3.75	2.15	5.13	1.54
Observe	3.79	1.97	5.03	1.35
Omit	3.14	2.26	4.23	1.48
Ooze	4.86	2.12	2.77	1.45
Open	5.11	1.89	5.90	0.94
Operate	4.15	1.84	4.33	1.37
Pack	4.30	2.08	4.70	1.22
Paint	5.50	1.74	4.50	1.52
Pamper	3.65	1.94	3.07	1.59
Patter	3.30	2.06	2.47	1.26
Pay	4.32	2.19	5.63	1.20
Peek	5.26	1.52	3.80	1.64
Permit	2.83	1.74	4.17	1.59
Pick	4.46	1.98	4.87	1.59
Play	5.37	1.80	5.67	1.22
Quake	4.41	2.42	3.00	1.55
Qualify	2.55	1.68	4.07	1.59
Quench	4.40	2.11	3.27	1.34
Quit	3.60	2.04	5.53	1.28
Quiver	5.40	1.51	2.97	1.52
Raise	3.93	1.87	4.43	1.58
Ramble	4.15	1.94	3.40	1.67
Rap	4.77	2.06	4.37	1.83
Rattle	5.44	1.55	3.37	1.60
Reach	5.39	1.76	5.40	1.25
Read	4.86	1.91	6.47	0.88
Receive	3.77	1.83	5.07	1.24
Reduce	3.04	1.97	4.70	1.59
Relax	5.24	2.03	5.93	1.29
Return	3.67	2.00	4.93	1.55
Ride	5.00	1.83	5.60	1.17
Rip	5.54	1.68	4.20	1.56
Roam	4.92	1.75	3.53	1.61
Row	5.71	1.59	3.97	1.74
Rub	5.94	1.56	4.70	1.53
Run	6.13	1.49	5.70	1.10
Rush	5.32	1.79	4.87	1.69
Save	3.10	1.83	5.67	1.04
Say	3.77	2.10	6.33	0.75
Scald	4.88	1.83	3.07	1.34
Scan	4.60	1.99	2.97	1.56
Scour	4.73	2.15	2.90	1.51
Scowl	4.90	2.01	3.07	1.41
Scramble	5.04	1.82	3.50	1.48
Scrape	5.30	1.66	3.47	1.33
Scream	6.51	0.98	5.17	1.29
Scrub	5.69	1.35	3.70	1.53
See	4.77	2.08	6.23	1.23
Sell	4.23	2.00	5.20	1.33
Send	3.64	1.97	5.53	1.09
Serve	3.89	2.01	4.87	1.33
Set	2.57	1.63	4.77	1.48
Sew	4.98	2.02	4.83	1.69
Shake	5.70	1.55	4.33	1.53
Shape	3.70	1.99	4.87	1.38
Shave	5.63	1.74	5.17	1.10
Shift	3.80	1.76	3.90	1.42
Shine	5.23	1.68	5.10	1.30
Shout	6.05	1.51	5.20	1.17
Shove	5.79	1.33	3.73	1.67
Show	3.61	1.81	5.77	1.09
Shrug	5.39	1.68	3.57	1.20
Sip	5.43	1.70	3.93	1.59
Sit	4.89	2.24	6.13	1.15
Skid	5.98	1.49	3.57	1.65

Table 1 Continued

Verb	EI Mean	EI SD	f Mean	f SD
Skim	4.57	1.81	3.83	1.69
Sleep	5.73	1.83	6.73	0.68
Smell	5.17	1.91	5.20	1.54
Smile	6.02	1.54	6.60	0.49
Sniff	5.42	1.58	3.83	1.44
Stir	5.05	1.93	4.17	1.65
Stop	5.36	1.81	6.30	1.00
Sweep	5.62	1.61	4.50	1.18
Swing	5.98	1.48	4.03	1.58
Take	3.92	2.04	6.23	0.80
Talk	5.67	1.70	6.67	0.47
Think	4.33	2.29	6.63	0.60
Throw	5.90	1.36	5.33	1.37
Tickle	6.26	1.26	4.40	1.25
Tile	4.67	1.86	2.97	1.72
Tip	4.23	2.14	3.63	1.56
Toss	5.67	1.60	4.07	1.46
Touch	5.79	1.46	5.53	1.48
Tow	4.55	1.90	3.60	1.47
Tread	3.57	1.92	2.97	1.47
Trim	4.99	1.85	3.87	1.20
Try	2.82	1.82	6.50	0.56
Turn	4.36	2.15	5.37	1.20
Twist	5.50	1.69	4.10	1.25
Uncover	4.87	1.93	3.93	1.21
Undergo	2.49	1.77	3.33	1.53
Underline	4.15	2.30	4.33	1.58
Understand	3.37	2.04	6.37	0.71
Understate	2.05	1.47	3.33	1.81
Undo	4.00	2.01	3.33	1.68
Unite	4.64	1.91	4.70	1.81
Unravel	5.25	1.63	3.17	1.44
Urge	3.60	2.00	4.13	1.52
Use	2.24	1.62	5.87	1.20
Vanish	4.90	2.12	3.33	1.45
Vibrate	5.62	1.62	3.67	1.40
Violate	3.27	2.00	3.90	1.47
Visit	4.17	1.76	5.77	1.09
Vocalize	4.50	2.08	3.30	1.93
Wade	5.39	1.80	3.20	1.33
Wag	5.13	1.78	2.70	1.35
Wait	3.94	1.97	6.17	1.00
Walk	5.74	1.53	6.13	1.12
Want	2.90	2.09	6.53	0.62
Warn	3.80	1.85	4.57	1.33
Wash	5.50	1.66	6.47	0.62
Watch	4.36	2.06	6.00	0.86
Wear	3.69	1.97	6.17	0.97
Weave	5.31	1.83	3.73	1.41
Weep	5.90	1.40	3.53	1.48
Weigh	4.24	2.17	5.63	1.20
Whistle	5.75	1.64	4.33	1.60
Will	2.05	1.57	6.77	0.50
Wink	5.64	1.64	3.87	1.45
Wipe	5.04	1.97	4.57	1.36
Wish	3.77	2.05	6.23	0.96
Work	4.99	1.98	6.27	1.09
Wring	4.86	1.97	3.00	1.53
Write	5.35	1.93	6.30	1.07
Yield	3.71	2.09	4.40	1.56
Zoom	4.54	2.17	2.40	1.33

EXPERIMENT II

Just as Paivio and others have assumed that the differences in mean ratings on nouns indicate differences

Table 2
Mean Correct as a Function of Stimulus and Response Enactive Imagery (High vs Low)

Stimulus	Response	
	High	Low
High	4.083	3.667
Low	2.458	2.250

in the extent to which the nouns elicit visual-based imagery, the present ratings on verbs were assumed to reflect differences in action-based imagery. Experiment II was designed to determine the effects of high and low enactive imagery words on the learning of paired associates. It was expected that the results with verb pairs which varied in EI would be similar to the results reported with noun pairs which varied in visual imagery. If it is assumed that performance is superior with high imagery words because of the possibility of a dual memory trace (word plus image), imagery based on nouns and verbs would be expected to facilitate paired-associate learning in a similar manner. Even though the image might be based on different sensory experiences, there is no reason to expect that EI would produce effects dissimilar to those produced with visual imagery.

Method

Subjects. The Ss were 48 undergraduate college student volunteers from the same pool as for Experiment I. The task was presented in group sessions.

Materials. Twenty-four high EI verbs (H) were selected from verbs having mean ratings of 5 or greater. The 24 low EI verbs (L) were selected from verbs having mean ratings of 4 or less. High and low EI sets of verbs were equated for mean rated frequency of occurrence. The high EI verbs were: *Throw, Cut, Jump, Sweep, Rub, Wink, Swing, Shout, Cook, Fly, Laugh, Whistle, Wash, Break, Drive, Knock, Run, Eat, Tickle, Sleep, Fall, Climb, Talk*, and *Touch*. The low EI verbs were: *Get, Raise, Need, Begin, Show, Quit, Ignore, Say, Contain, Send, Return, Observe, Wear, Come, Wait, Make, Serve, Change, Compete, Use, Join, Save, Obey*, and *Control*. Two 24-pair lists were constructed such that there were six pairs of each of the following combinations of stimulus and response items on each list: H-H, H-L, L-H, and L-L. Pairs with obvious meaningful associations were not used. The two lists differed in which words were paired.

Procedure. Half of the Ss learned each of the two lists. Ss were instructed that all the words to be learned were verbs. In addition, they were told that it might help them to learn the pairs if they imagined each when they heard it. That is, it might help if they paid attention to the action experience called up by the verbs.

Two alternating study and test trials were given. On each study trial, the pairs were read aloud at a 3-sec rate. On test trials, the stimulus word alone was read and approximately 5 sec allowed for Ss to respond. Ss wrote their responses on the provided test sheets, on which were 24 numbered blanks. The number corresponding to each stimulus word was presented by E immediately preceding each stimulus, e.g., one-wear, two-jump, etc. A different random order of presentation was used on each trial.

Results

The mean number of correct responses on the two trials for each combination is presented in Table 2. The means ordered as expected: H-H, H-L, L-H, L-L, with performance on H-H pairs being best. The two-way analysis of variance with repeated measures revealed that EI value was a significant factor on the stimulus side only [$F(1,47) = 31.82$, $p < .001$ for stimulus EI value and $F(1,47) = 2.18$, $p < .10$ for response EI value]. The interaction was nonsignificant [$F(1,47) = 0.26$].

As expected, the facilitatory effects of high EI verbs on the stimulus side were consistent with the findings of Paivio and others, with nouns (Paivio, 1969). The effects of EI on the response side were in the direction that would be predicted from the work with noun pairs but failed to reach significance. It is likely that use of a 24-item rather than the more usual 16-item list was responsible for the failure of the response mode effect with verbs. A 24- rather than 16-item list was employed with the assumption that high task difficulty would maximize the likelihood of a facilitatory imagery effect. The increased list length apparently had the opposite effect.

EXPERIMENT III

In Experiment II, words which could serve as nouns as well as verbs were not eliminated in the preparation of materials. It could be argued that Ss' better performance on H-H pairs than on pairs containing a low EI verb was due to the fact that more high than low EI words have dual noun and verb functions. That is, the results could be interpreted as due to the imagery evoked by nouns rather than by verbs, although considerable care was taken in Experiments I and II to instruct Ss that the words to be rated and learned were verbs. A check was deemed necessary. Accordingly, a new list of pairs was constructed which consisted of words functioning as verbs only. It was expected that the results with the new list would replicate those found in Experiment II and allow for more confident interpretation of the results of both studies as due to the effects of EI.

Method

Subjects. The Ss were 18 undergraduate college students selected from the same pool as for Experiments I and II.

Materials. Two 16-item paired-associate lists were constructed such that there were four pairs of each of the following combinations of stimulus and response items on each: H-H, H-L, L-H, and L-L. The two lists differed in which words were paired. Sixteen, rather than 24, pairs were used in Experiment III to make the task more comparable with the list length utilized by Paivio (1965).

The criteria for verb selection in Experiment II were again employed with one additional criterion. Only words which function as verbs or retain the same meaning when used as nouns were used (e.g., to gulp, a gulp). Judgments were made on the basis of Webster's New World Dictionary. This criterion was adhered to with a couple of exceptions due to difficulty in finding words which function only as verbs. These exceptions had extremely obscure usages as nouns.

The high EI verbs were: *Mow, Wade, Wipe, Eat, Explore, Write, Relax, Reach, Stir, Gulp, Knock, Build, Carve, Vibrate, Scramble*, and *Beg*. The low EI verbs were: *Begin, Obey, Quit,*

Observe, Join, Use, Say, Contain, Try, Save, Take, Combine, Attach, Do, Receive, and *Send.*

Procedure. The procedure was identical to that for Experiment II.

Results

The mean number of correct responses on the two trials for each combination is presented in Table 3. The ordering of means was as expected: H-H, H-L, L-H, L-L, from high to low. Stimulus and response EI were found to be significant effects, as was the Stimulus EI by Response EI interaction [$F(1,17) = 25.58$, $p < .01$; $F(1,17) = 15.44$, $p < .01$; and $F(1,17) = 9.60$, $p < .01$, respectively].

The superiority of performance when the stimulus was high in rated EI was consistent with the results of Experiment II, suggesting that the results of that study were appropriately attributed to the imagery evoked by verbs. The results of Experiment III did differ from those of Experiment II in the finding of a significant response imagery main effect and a significant interaction. This effect of imagery on the response side with verb pairs is consistent with the findings reported by Paivio (1965, 1969) with 16-item lists. The shorter list length apparently was more sensitive to response imagery effects, although it should be noted that not only list length but items varied in the two studies.

Inspection of means indicated that response EI was not an equally effective variable with high and low EI verb stimuli. High EI on the response side was found to be more effective when the stimulus verb was of high EI value. Response EI value had little effect when the stimulus was of low EI value (L) but made a considerable difference when the stimulus was of high EI value (H). The interaction suggests that Ss may have formed compound images during learning, formation being possible only when both elements were high in imagery (i.e., H-H). Ss may have been able to image the two activities being carried on simultaneously.

The mediator which Ss are inferred to have utilized in the present experiments is assumed to be nonverbal, just as the mediator inferred from the effects of noun concreteness on learning is assumed to be nonverbal. The mediator in both cases is assumed to be imagery. It is proposed, however, that the specific sensory modality in which a word evoked a memory image differs with verbs and nouns, being action with verbs and vision with nouns. It is, of course, capricious to expect that the role of either form of nonverbal representation has been isolated in studies with nouns or verbs. There are undoubtedly whole complexes of sensory experience aroused by words, whether nouns or verbs. It is likely that compound images based on noun pairs are facilitatory to learning in part because of the action implicit in the compound. A compound image would be no more than the juxtaposition of actors or objects if an activity component were not simultaneously imaged.

Table 3
Mean Correct as a Function of Stimulus and Response Enactive Imagery (High vs Low)

	Response	
Stimulus	High	Low
High	4.167	2.000
Low	1.667	1.389

Likewise, the compound image based on verb pairs is probably facilitatory in part because of the concreteness of imaged actors and objects.

Although the extent to which the action image occurs conjointly with or independent of the visual image of actors and objects is yet to be determined, the importance of the action component in facilitating learning cannot be overlooked. Rowher (1966), for example, found that the best association by verbal means of two nouns is produced by an "actor-action-object" phrase. The superiority of learning when two words are joined by an action verb rather than a preposition suggests that activity, not simply "relationship," is an important mediating stimulus. Relationship has been shown to be an important factor in associative learning (Asch, 1969), but the results of studies involving an activity component suggest that the action even further facilitates associative learning. Another study by Rowher (1967) underscores this point. It was found that associative learning was facilitated when animated rather than static interactions were presented. Unless one assumes that random activity would have produced the same results as the meaningful action in the latter Rowher study, the effects must be attributed to the availability of a mediating stimulus in addition to the visual image. That additional mediating stimulus is best conceptualized as imagery based on the arousal of previous action experiences, or EI.

Two additional arguments for the necessity of postulating a form of representation apart from the visual image can be given. First, activities are not tied to particular agents or objects generally, but may be performed by many actors including the S. The abstraction of those many contexts in which an activity may have occurred or been experienced may be experienced as the enactive image. A second argument for the necessity of postulating EI that can occur separately from the visual image is the relative unpicturability of many types of actions. The verbs to relax, to gulp, to eat, for example, have some observable aspects, but many which are not evident to an observer and, hence, are not representable by visual image. Those unobservable aspects are representable in the form of EI. That action may often occur conjointly with the visual image does not obviate the necessity of postulating that Ss form and utilize nonvisual images to represent action experience or that nonvisual images may serve as facilitating mediational stimuli in associative learning.

REFERENCES

Asch, S. Reformulation of the problem of association. American Psychologist, 1969, 24, 92-102.

Bruner, J., Olver, R., & Greenfield, P., et al. *Studies in cognitive growth*. New York: Wiley, 1966.

Noble, C. E. The meaning-familiarity relationship. Psychological Review, 1953, 60, 89-98.

Paivio, A. Abstractness, imagery, and meaningfulness in paired-associate learning. Journal of Verbal Learning & Verbal Behavior, 1965, 4, 32-38.

Paivio, A. Mental imagery in associative learning and memory. Psychological Review, 1969, 76, 241-263.

Paivio, A. On the functional significance of imagery. Psychological Bulletin, 1970, 73, 385-392.

Paivio, A., Yuille, J., & Madigan, S. Concreteness, imagery, and meaningfulness for 925 nouns. Journal of Experimental Psychology, 1968, 76(1, Pt. 2).

Piaget, J., & Inhelder, B. *L'image mentale chez l'enfant*. Paris: Presses Universitaires de France, 1966.

Rowher, W., Jr. Constraint, syntax, and meaning in paired-associate learning. Journal of Verbal Learning & Verbal Behavior, 1966, 5, 541-547.

Rowher, W., Jr. *Social class differences in the role of linguistic structures in paired-associate learning: Elaboration and learning proficiency*. Basic Research Project No. 5-0605, Contract Nonr OE 6-10-273, 1967, United States Office of Education.

(Received for publication May 22, 1973;
accepted October 21, 1973.)