Psyke & Logos, 1993, *14*, 441-456

SYMBOLIC FORMS AND COGNITION

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Here we examine a kind of semantic relation – symbolism. In symbolism, an item stands for another item, without necessarily being a word or a conventional sign. The relation between the two items can even appear to be appropriate without subjects needing to be taught a convention. We report a series of experiments. The first shows how symbolism is evident in a judgment task whose results reveal consensus between subjects on a list of pairs of words. We then go on to use this consensus, to show how a list revealing consensus affects reaction time, and affects recall. We discuss the basis of the results, considering how symbolism is related to aesthetics, and cognition in general.

A well known example of symbolism that has been examined in the experimental psychology of aesthetics, particularly that branch studying »expression«, is that colours and forms can symbolize. The colour green, for instance, is readily accepted by many people as a symbol for LIFE or NATURE. A circle can readily symbolize the UNIVERSE or CONTENTMENT. A square is STABLE in this company. Symbolism encompasses a broad range of phenomena. Despite its range, very few of the phenomena of symbolism have been studied experimentally, though they have been a special purview of psychology of aesthetics, where generally they have been studied in the guise of cross-modal matches or synesthesia. Nevertheless, they are the subject matter of cultural anthropology, they are used extensively in the arts (Gombrich, 1960, 1972), including literature (Marks, 1974), and they are also employed in design for example in the creation of logos and packaging. A basic fact is that people frequently use symbols to represent or stand for a range of concepts. A kind of symbolism is present when we use a dove for PEACE, a lion for BRAVERY, and a lotus for PURITY. (See Vicari, in press, for a history of pictorial »emblematica« in this vein.)

A brief note on terminology is necessary here. In the above examples, the colour green, the form circle, or the word »green« and the word »circle«, can be called »symbols«. LIFE and UNIVERSE are what the symbols stand for. They are the symbol's referents. Symbols are typically »directional« – A is a symbol of B, but B is not a symbol for A. They are not examples of one another, e.g. a circle is not an example of CON-

TENTMENT and vice versa. That is, in symbolism, representation occurs without exemplification. Noticing the diverse usage of the term »symbol« across disciplines, Smythe (1984) has proposed a range of »symbolic systems« are the central topic of cognitive science. Symbolic systems, he notes, range from narrowly defined ones such as computer-based »physical symbol systems« to grandiose ones such as »mytho-religious symbol systems«.

The major concern here is not just whether a form or colour can have a symbolic meaning, and not just what form or what colour can have what meaning. Rather, our key questions here are, first, do people show a consensus on these meanings, and, second, how do they affect cognition, in particular how do they relate to reaction times and recall?

Unlike the study of meaning in colours, which is given the name »colour symbolism«, the study of form symbolism is historically called »physiognomic perception« (Werner, 1948). Like Lipps (1900), in his theory of empathy, Werner regards physiognomic perception as a mode of perception in which objects are perceived through an organism's motor and affective attitudes. He argued, rather dramatically, that subjects »fuse« external and internal stimuli, and »the high degree of unity between subject and object mediated by the motor-affective reactivity of the organism results in a dynamic, rather than a static, apprehension of things« (p. 67). Schlesinger (1980) gives physiognomic perception an explicit definition: »It is perception whereby the perceiver tends to suffuse percepts with an emotional, affective, or expressive quality« (p. 74). Despite its being a widely accepted term, »physiognomy« has the disadvantage of being unable to capture an important aspect of symbolism. Namely, it fails to indicate that forms might also convey emotionally-neutral referents, and gives the impression that the meaning is limited to the motor and affective domain. This is likely not the case, because people do represent quite abstract concepts (that might be emotionally neutral) by forms. A circle, for example, may represent ETERNITY. Hence, we will often refer to »form symbolism« to note the ability of forms to represent referents that can range from the very concrete to the highly abstract. Our term parallels »colour symbolism« which is used to describe the comparable ability of colours.

In the following, we will give a brief review of methods and theories in the psychological literature of the symbolic meaning of forms. We will then analyze weaknesses and strengths.

A Literature Review

Schlesinger (1980) noted studies of physiognomic perception have been based largely on two basic methods (see Wapner and Werner (1957) and Werner and Kaplan (1963)). In the »production method«, subjects are

usually given some words and are asked to produce lines and shapes to represent the meanings of the words (such studies include e.g. Krauss, 1930; Hevner, 1935; Hall and Oldfield, 1950; Hall, 1951; Lyons and Scheerer, 1951; McMurray, 1958; Scheerer and Lyons, 1957; Inui and Yuto, 1972). The general result of these methods is significant consensus: Most subjects use lines or shapes with the same features to represent a word. For example, subjects tend to draw a line or a pattern in a horizontal direction when the word given is »quiet«. As one might expect, the same line or pattern can also represent synonyms that are related to calmness such as »tranquil« and »serene«. The other method is called the »comprehension method«, in which both lines or shapes and words are given to the subjects. The subjects are asked to judge which line or shape fits with which word (Lundholm, 1921; Scheerer and Lyons, 1957; Peters and Merrifield, 1958; Werner and Kaplan, 1963; Kreitler and Kreitler, 1972; Hochberg, 1978). The findings are similar to those from the production method. Namely, there is usually high agreement on which form fits with which figure. For example, when given a wavy line and an angular line, and the words »wood« and »iron«, people tend to match »wood« with the wavy line and »iron« with the angular line. The results of the studies can be summarised as follows:

1. There is consensus on what lines or forms can represent.
2. Lines and forms can represent emotional, kinetic, and cross-modal referents.

The evidence from developmental research is not so clear cut. On one hand, Neisser (1967) claims »according to many developmental psychologists, they (i.e., physiognomic perceptions) are the rule rather than the exception in children« (p. 196. Reference is not given). On the other hand, some studies (Honkavaara, 1961; Nathan and Hass, 1970) found that it is only older age groups that have consistently manifested physiognomic sensitivity. In order to resolve the apparent contradiction between studies of children's capacity to appreciate and produce metaphoric language, Gardner (1974) tested a wide range of age groups. He found there is a steady increase in children's agreement on mapping polar adjectives, such as »happy-sad« and »loud-quiet«, onto two lines, and various sensory domains. His data showed a steady increase with age in the children's agreement on mapping the adjectives onto different domains. By age eleven and a half, they are able to reach the level of agreement of adults. But even preschoolers performed the task at a level above chance. More evidence along this line can be found in Lawler and Lawler (1965), Walton (1936), Werner (1955), Werner (1956) and Lindauer (1984).

Some apparent differences in the conclusions in studies of children's physiognomic perception may be due to the nature of different tasks being employed, as Maurer (1993) contends. A circle may not only evoke sensory

concepts that are not primarily visual, it may also evoke a response like »life« whose referent does not belong to any particular sensory modality. This complexity may help account for the diverse developmental findings, because different aspects of physiognomic perception may be specific to different developmental stages. Sensitivity to the expressive mood of pictures seems to belong to a rather late developmental stage (Machotka, 1966; Carothers and Gardner, 1979).

Most studies on physiognomic perception were done by testing the subjects through vision. But there is a strong indication that the expressiveness of lines and shapes is not specific to vision. Kennedy (1993) finds qualities such as hardness and softness can be depicted by a texture of zig-zag lines and sinusoids respectively in raised-line drawings for the blind. He discusses a range of expressive characteristics of lines understood by the blind and the sighted alike.

Finally, cross-cultural studies (Osgood, 1960; Osgood, May and Miron, 1975; Jakobovits, 1969) suggest some of the expressive meanings attached to forms might be universal. For example, a crooked line is commonly regarded as »noisy« by Anglo-Saxon Americans, Navajo Indians, and Japanese alike. (But see Rogers and Ross, 1975, for a negative finding.)

The relation between theory and empirical studies

The theories intended to actually explain symbolic and physiognomic phenomena are vague. Most of them are post hoc, construed without a basis for making a prediction. Nonetheless, these theories fall into several groups. First – since it is the most influential theory – is Gestalt theory. Arnheim (1949, 1954) applies the Gestalt principle of isomorphism to explain the perception of expressive qualities. He argues that »expression is the primary content of perception« (1949, p. 164). In other words, perception is inherently related to expression, according to Arnheim. When we see a curvy line, we do not »associate« it with some expressions, he contends. We simply see expression just the way we see the curvy line. There is no difference in principle in the way we see the line and the way we see its expressive meaning, in this theory.

Schlesinger (1980) has described an S-R theory of physiognomy. According to this theory, emotional experience and perceptual experience are not inherently related. Their connection is learned, via an association mechanism and strengthened by reinforcement. Scheerer and Lyons (1957) developed a related theory in some detail. A similar view is developed by Wallach and Kogan (1965) and Ekman (1960). Without endorsing an S-R view of learning, several theorists contend lines carry over the meaning of the objects of which they have been constituent parts and the habitual properties of lines are resonances of multitudes of experiences. A common feature of all learning theories, we should stress, is that they do not assume

that expression is inherent in perception.

Kennedy (1993) has pointed out a salutary problem for attempts to find explanations of physiognomic perception in features found in the observer's environment: Counterexamples are easy to find. Although wavy lines could be like fur and angular lines could be like metallic blades, one could also note that rounded stones from a brook are hard and the angular outlines of maple leaves are soft. So the attempts to explain meanings that are assigned to forms by referring to their featural resemblance to natural objects are unduly selective and post hoc, rather than based on clear rules apparently working unequivocally in the physical environment. He suggests »the Gestalt theory that formal properties are used by the perceiver, independent of an ecological referent, has much validity« (p. 285). But unlike Gestaltists, he deems an explicit theory of »affordances« to be necessary in deciphering the puzzle of expression. The term »affordance« was coined by J. J. Gibson. Gibson's (1979) theory of affordance is concerned with the usefulness of parts of an environment. »The affordances of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill« (p. 127). He argues that the composition and layout of surfaces may constitute physical factors which determine what they afford for good or ill. Hence the meanings or the values of things can be perceived directly by the organism. However, Gibson's theory does not set out why and how forms may convey abstract meanings such as LIFE or ETERNITY.

A different version of learning theory would argue the expressive meaning is neither inherent in forms and perception, nor accumulated by experiences via S-R conditioning. Rather, it is acquired by following an explicit convention. In each culture in which symbolism is evident, the theory contends, forms and colours are like a system of signs. Forms are like words in natural languages. Just as the connection between the sound of a word and the meaning of the word is arbitrary, so there is only an arbitrary connection between a form and a symbolic meaning. What makes a form and a meaning be related together purely depends on convention, just like what makes the sound and the meaning of a word go together is a convention. Goodman (1968) has supported this view. Winner (1982) has called this theory »constructivist-conventional theory«.

Critique

Consider some common weakness of the theories and the empirical results. First, the research emphasizes cross-modal and emotional referents, neglecting higher-order cognition, with no clear theoretical rationale for this limitation. Second, there are very few links between the extant empirical studies and the theories. The empirical studies do not seem to be able to support or reject any general theoretical positions (apart perhaps from

developmental ones). There are no clear, testable explanations apart from erroneous ones such as »all hard things are angular«. We are left with a few generalizations such as »angular things can be taken to indicate hard things«. Since most investigations do not manipulate the learning conditions to which they allude, or the stimulus variables they ostensibly employ, the general theories become post-hoc speculations.

A third weakness of the theories is they do not specify the underlying mechanisms, except in vague metaphors. For example, how do people »fuse« their »inner feeling« with the »external stimuli«? Also, suppose we follow a theory of empathy, why and how does the empathic act help us to single out and retrieve a *relevant* concept such as UNIVERSE and ETERNITY from our conceptual repertoire to perform an appropriate response? A reference to »fusion« will not indicate specifically which stimuli will evoke what referent. (Still less clearly answerable: How can we »fuse« with UNIVERSE or ETERNITY?) In a chicken-and-egg puzzle we might ask if we have never learned in advance that these concepts can be associated with a circle, how are we able to judge the appropriateness of the form for the referent? Many similar issues arise in discussion of »Metaphors We Live By« (Lakoff and Johnson, 1982). Kennedy and Vervaeke (in press) describe the conundrums at length.

Hence, at the moment many theoretical questions about forms and symbolism are largely unanswerable. However, they can be finessed, and useful questions answered about the work of symbolism – its effects in cognitive problems. Here, we will attempt to demonstrate cognitive aspects of form symbolism, including consensus on matches of shapes and complex concepts, and related effects in a cognitive task.

Experiments

In our first experiment subjects are given a matching task. The agreement or »consensus« on the matching task is measured. The second experiment uses the same task but examines the effect of symbolic relatedness on reaction times that are required for the task. The third experiment examines the effect of symbolic relations on memorization (shown in a recall task).

All our experiments use the figures of a square and a circle presented with a pair of words. Our emphasis is simply on effects of symbolic relations on cognitive tasks, we should note, not on the »optimum shape« to symbolize a particular referent or the »optimum referent« for a particular shape. What we need to establish is that people agree or disagree on a set of judgments. That is, subjects are asked whether the circle or the square is better at standing symbolically for the meaning of a given word. Circle and square are chosen for the reasons that they are simple, contrasting in various ways, familiar and easy to ask about. As such, they can provide a basis for a clear cut consensus – the requisite step needed before

studying symbolism's effects on reaction time and memory. Further, twenty word pairs were devised. The word pairs were antonyms (such as good-evil), or contrasting, related pairs (e.g. mother-father). A range of these pairs was devised, in order to have some pairs that might result in high levels of consensus, and some low in consensus. We included some sensory-affective pairs, but a majority of the pairs were highly abstract.

Experiment 1 and Its Replication: Matching Words with Shapes

In Experiment 1, subjects were required to match pairs of words to shapes. The question that Experiment 1 addresses is how much agreement can be found between subjects.

Method

Subjects. The 72 subjects were undergraduates at the University of Toronto. One group of 47 was from a perception course, and the remaining 25, in a replication, were from an introductory psychology course.

Stimuli. There were two shapes, a 5cm diameter circle and a 5cm square. The 20 word pairs included 8 sensory or affective pairs (soft-hard, bright-dark, light-heavy, warm-cold, quiet-loud, far-near, happy-sad and love-hate) and 12 more abstract pairs (mother-father, good-evil, alive-dead, summer-winter, fast-slow, weak-strong, spring-fall, cat-dog, walking-standing, even-odd, animal-plant, deep-shallow). Both shapes and words were presented on a computer screen.

Procedure. Subjects were tested individually on a IBM compatible computer display terminal. The pair of shapes was shown circle on left and square on right, or vice versa, at random. Initially, the pair of words was shown below this, arranged with one word above the other, also in randomized order. The subjects were instructed to match the word pairs with the shapes. The subjects made their judgments by pressing one of the two keys on the key-board. The key presses moved the words to the centres of the shapes to show what shape/word assignment the subjects favoured. Subjects could then confirm or revise their answer.

Results and Discussion

The results of Experiment 1 together with its replication are shown in Table 1. The agreement ranged from 100% to 51% (chance). High agreement pairs (above 90% on both lists) were soft-hard, happy-sad and mother-father, all of which were matched with circle and square respectively. Word pairs above 85% on both lists were love-hate, good-evil, bright-dark, alive-

dead and light-heavy, with the first word of the pair being the one matched with circle. High agreement pairs include 3 abstract pairs – mother-father, good-evil, and alive-dead. Experiment 1 and its replication are highly correlated ($r = 0.88$, $p < 0.0001$). Both found 10 word pairs with agreement over 80%, and only the tenth word pair on each list, in order of level of agreement, slipped below 80% on the »other« list.

Table 1: Agreement in Percentages

OBS	WORD PAIRS (Circle Square)	EXPT 1 (n = 47)	REPLICA (n = 25)
1	Soft Hard	100	92
2	Happy Sad	94	92
3	Mother Father	94	92
4	Love Hate	89	96
5	Good Evil	89	92
6	Bright Dark	87	92
7	Alive Dead	87	88
8	Light Heavy	85	92
9	Summer Winter	81	84
10	Warm Cold	81	76
11	Fast Slow	79	80
12	Weak Strong	79	56
13	Spring Fall	74	76
14	Cat Dog	74	72
15	Quiet Loud	62	56
16	Walking Standing	62	52
17	Even Odd	57	56
18	Animal Plant	53	60
19	Far Near	53	60
20	Deep Shallow	51	60

The results reveal reliable form symbolism in which shapes symbolize complex ideas. The replication demonstrates the robustness of the symbolic links. It is worth noting that the three high-agreement abstract pairs are not synonyms, i.e. mother-father is not synonymous with alive-dead or good-evil. While the high-agreement list is largely sensory-affective, we regard this as a sampling issue. Clearly we could add or subtract examples of the word pairs and change the high-agreement list to be largely abstract.

Experiment 2: Reaction Times on the Matching Task

How does the relation between a shape and its symbolic meaning affect reaction times? If the shape and the meaning are closely related, does it take less time to make a matching judgment than when given a less related shape and meaning? If so, the judgment time should correlate negatively with the degree of agreement found in Experiment 1.

Method

Subjects. The 31 undergraduate subjects were students from an introductory psychology course at University of Toronto.

Stimuli. These were the word pairs and shapes used in Experiment 1.

Procedure. The procedure of this experiment were mostly the same as Experiment 1, except for the following changes: 1. Subjects were asked to make their judgments as quickly (and as accurately) as possible. 2. Unlike Experiment 1, the judgment could not be revised or confirmed. 3. Each trial began with the presentation of shapes, together with a warning sound. The presentation of words followed after 0.5 second. The brief interval were made to allow the subjects to identify on which side each shape was presented. 4. Subjects were also given a training session before the actual experiment started. In the training session, subjects were asked to practice the same number of trials as the real situation. The word pairs for training were all different from the words that were used in the actual test.

Results and Discussion

The results are shown in Table 2. The second column in Table 2 shows the list of words. The third column shows the mean reaction time across subjects. The fourth column shows the percentage of agreement in this experiment. The fifth column shows the percentage of agreement in Experiment 1 and the last column shows the replication of Experiment 1. Correlation analysis between the agreement scores coming from the different experiments and the reaction time data reveals negative correlations between degree of agreement and reaction time. The correlation coefficients between the reaction times and the agreements from this experiment, the first experiment and the replication of the first experiment are -0.57 ($p < 0.008$), -0.65 ($p < 0.001$), and -0.62 ($p < 0.004$), respectively. This means higher consensus word pairs require less reaction time, whereas lower consensus word pairs require more reaction time. Also, significant positive correlations are found between agreement measures in Experiment 2 and Experiment 1 (0.72, $p < 0.0003$), as well as Experiment 2 and the replication of Experiment 1 (0.65, $p < 0.002$).

Evidently, the high consensus words generally require less reaction time in a test of form symbolism. The upper ten word pairs on the agreement scale (measured in Experiment 1) are about 250 milliseconds faster than the lower ten word pairs on the agreement scale. If we compare the top 5 high-consensus word pairs with the bottom 5 low-consensus word pairs, the difference is about 570 milliseconds.

(Quiet-loud may be an exceptional pair, for it has a comparatively short

Table 2

OBS	WORD PAIRS	RT(MS)	MATCH	EXPT 1	REPL 1
1	Alive Dead	1990	87	87	88
2	Fast Slow	2185	58	79	80
3	Love Hate	2264	87	89	96
4	Soft Hard	2290	90	100	92
5	Happy Sad	2315	77	94	92
6	Cat Dog	2330	74	74	72
7	Quiet Loud	2387	84	62	56
8	Mother Father	2468	90	94	92
9	Summer Winter	2548	71	81	84
10	Spring Fall	2551	87	74	76
11	Light Heavy	2627	90	85	92
12	Bright Dark	2648	84	87	92
13	Good Evil	2669	84	89	92
14	Plant Animal	2683	58	53	60
15	Warm Cold	2735	61	81	76
16	Weak Strong	2759	77	79	56
17	Deep Shallow	2928	61	51	60
18	Walking Standing	3000	65	62	52
19	Odd Even	3067	61	57	56
20	Far Near	3189	52	53	60

reaction time, though the level of agreement was only high in this reaction-time experiment.)

Experiment 3: Recall Task

Experiment 3 is intended to show that symbolic relations can aid performance on a recall task.

In Experiment 3, two groups of subjects were asked to remember a list of items. The items to be recalled were pairs of words presented in a circle and a square. The subjects were asked to remember which word in each pair was presented in which shape. The only difference between the two groups is that, in one group, the words shown in the shapes were in accord with the consensus obtained in Experiment 1, while in the other, the words shown in the shapes are discordant with the consensus of Experiment 1. For example, in the »accord« group, words like »soft«, »mother«, etc. are presented in the circle, whereas words like »hard«, »father«, etc. are presented in the square. In the »discord« group, however, the words »soft«, »mother« etc are presented in the square, whereas the words »hard«, »father« etc. are presented in the circle. Hence the »discord« group is presented with pairings that are the reverse of the consensus. Subjects are not informed of the associations between shapes and words.

Symbolic relations that are in accord with consensus should be easier

to recall in this task, Also, since the consensus ranges from high agreement to low agreement, the amount of agreement should influence recall.

Method

Stimuli. The materials used in Experiment 1 and 2 were also used here.

Subjects. The subjects were 36 undergraduate students at the University of Toronto. The subjects were assigned to the accord and discord groups at random, 18 per group.

Procedure. For both accord and discord groups, there was a learning phase and a test phase. In the learning phase, subjects were shown a circle and a square and a pair of words in each presentation. Each word was presented inside one of the shapes. The subjects were instructed to remember which word was in which figure. The paired words and shapes were shown randomly on a computer screen for 3.5 seconds, with each pair shown only once. The test phase followed immediately after the learning phase. In the test phase, the same pairs of words appeared on the screen and subjects were asked to move the words to the appropriate shapes. As in Experiment 1, subjects were allowed to change their initial answers before they started the next trial.

Results and Discussion

Results are shown in Table 3. The second column shows the consensus found in Experiment 1. The third and fourth columns show the percent correct score for each word pair under the accord and discord conditions. The top 10 word pairs on the agreement scale found in Experiment 1 were classified as high agreement pairs, and the bottom 10 word pairs as low agreement pairs. A two way analysis of variance shows a significant main effect for accord vs discord ($F = 38.10$, $p < 0.0001$), no main effect on level of agreement ($F = 1.84$, $p < 0.18$), but a significant interaction between accord vs discord and level of agreement ($F = 6.42$, $p < 0.01$).

The accord group showed a better recall performance than the discord group, and the high agreement pairs were better remembered than the low agreement pairs by the accord group, but they produce no benefit for the discord group.

There are also a few anomalies. Word pairs such as »deep-shallow« and »quiet-loud«, scored high in the accord group (89% and 100% respectively), though the consensus on them was only 51% and 62% respectively in Experiment 1. The cause of this discrepancy is not clear. We conjecture that they are ambiguous, in the manner of a duck-rabbit figure. That is, each term in each pair can be symbolized aptly by either circles or squares, in some curious, as yet little understood fashion.

Table 3

	Consensus n = 47	Accord n = 18	Discord n = 18
Circle Square			
Soft Hard	100	89	50
Mother Father	94	89	56
Happy Sad	94	78	56
Good Evil	89	83	72
Love Hate	89	89	56
Alive Dead	87	89	61
Bright Dark	87	89	72
Light Heavy	85	89	61
Warm Cold	81	83	78
Summer Winter	81	94	66
Weak Strong	79	78	61
Fast Slow	79	67	61
Cat Dog	74	78	56
Spring Fall	74	78	72
Quiet Loud	62	89	72
Walking Standing	62	61	72
Odd Even	57	67	50
Far Near	53	67	78
Plant Animal	53	78	72
Deep Shallow	51	100	67

The overall results seem to imply that the subjects were using symbolic relations as a mnemonic device or strategy to perform the task.

Discussions with the subjects indicated most subjects in the discord group did not seem to notice the pairings were reliably counter to their intuitions. However, one subject spontaneously reported that she found many pairings contradicted her intuition. She recalled better than other subjects.

One reason why many subjects did not notice the consistent pairings in the discord condition might be the consensus level of the pairs of words ranges from high to random. If only high consensus words were shown to the discord group (or if instructions are made explicitly to encourage the subjects to notice the relation between the words and the shapes) then the subjects may indeed be able to do better.

General Discussion

The general results demonstrate that form symbolism applies to cognitive as well as expressive and sensory referents. It produces consensus and also affects other measures of cognition, such as reaction time and recall performance. The »closeness« of the two symbolic matches appears to be measureable by consensus or reaction time or ease of recall. However, we should caution that these measures of closeness may not fully assess aptness in symbolism. It is quite conceivable that a subject might take a long time to make a judgment, but arrive eventually at a judgment that is felt to be convincing and apt.

We suggest the symbolic relations between the shapes and the words being tested here are mostly new to our subjects. The subjects, we suggest, are constructing an answer, rather than simply retrieving one. The processing time is considerably longer in our matching task than in most categorical tasks such as »classify X as a plant or an animal«. The typical reaction time for our subjects in the matching task was between 2 and 3 seconds. For many categorical tasks, the reaction time is often about 1 second (Chang, 1986). This difference may reflect the difference between a construction process and a simple retrieval process. Like us, Sperber (1977, 1980) regards the mechanisms of symbolism as a form of problem solving. However, we hasten to add that the symbolic relations we were testing could become automatic, and faster, with some drill on the word-pairs used here for instance. After some drill, the ability might even be speedy when applied to new word-pairs.

One could reasonably argue that the subjects in Experiment 3 do not have to remember the word-pairs they saw. They only have to complete a correct match. We agree. That is, all we claim, rather modestly, is that subjects examining a list to be recalled, do notice some factor to do with symbolism, can remember the factor, and use it to aid performance on recall.

Shape symbolism is not purely visual, if the referents can be highly abstract. By the same token, the shapes need not be purely visual, even if we have presented them visually in our experiments. We have tested two blind adults on shape symbolism, using the word-pairs of Experiments 1 to 3, and asking the blind subjects to match the pairs with imagined shapes. The first blind subject, Sanne, aged 20, has been totally blind since age 2. She concurred with the sighted consensus in Experiment 1 on 16 pairs ($p < .006$, one-tailed binomial test). She reversed quiet-loud, weak-strong, odd-even, and alive-dead, only the last of which is in the 10 high-agreement pairs in Experiment 1. The second blind subject, Kathy N, aged 40, has been totally blind since age 2 years 10 months. She concurred with the sighted on all but 2 pairs ($p < .001$, one-tailed binomial test). She reversed animal-plant and shallow-deep, two pairs receiving random matches with circle and square from the sighted in Experiment 1. Evident-

ly, shape symbolism is not likely to depend on visual input, even if instructions entail visual input at times.

Finally, we wish to acknowledge that we have finessed here the most important problem of all: What is the basis for form symbolism? We believe that the answer to this question remains obscure. Our own view at the moment is quite partial, at best. We can only suggest that there is a kind of metonymy at work in form symbolism. That is, one defining aspect of a form (e.g. sharpness of corners) matches exactly with one distinctive aspect of a referent (e.g. sharpness of icicles in winter, or edges of rough surfaces). In form symbolism, subjects detect the match of highly salient features. How those highly salient, defining characteristics are selected is uncertain. However, we propose that the time taken depends on a tree-like structure in cognition, with some features more »central« than others, and some features being »reached« only after others or »through« others. The tree can distribute activation via its branches, some thin and slow to distribute, and some thick and quick. What composes the features can indeed be »Gestalts« or »affordances« or »expressive characteristics«, but, also, we suggest, highly abstract form relations such as »infinite« or »unending« or »balanced«. The relations between the referent's features are also highly abstract, e.g. »necessary« or »inevitable« or »defining« or »characteristic«. The matching process between aspects of forms and features of their referents is a matter of conjecture, at the moment, we admit. However, our aim here is to provide the evidence to motivate a search for an analysis of symbolism. That search should include examples of highly abstract referents not just sensory, perceptual and emotional states. We believe we have provided good justification for that end. Form symbolism is, we aver, relevant to abstract concepts, and it operates in novel tasks, not just ones to which convention has supplied a habitual answer. It enables cognitive connections to be made, and it can support comprehension and memory.

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