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Chapter 8

Static Patterns Moving in the Mind

Jennifer J. Freyd and Teresa M. Pantzer

Some simple static patterns like arrows and triangles can produce a compelling sense of directionality (figure 8.1). In this chapter we explore the possibility that the phenomenal sensation of directionality is based on a dynamic mental representation (Freyd 1987, 1993). Results from three experiments suggest that memory for the position of static arrows and triangles is sometimes distorted in the direction that the pattern appears to point, as if the arrow or triangle moved in the mind. Then, using the Geneplore model of creativity (Finke, Ward, and Smith 1992) as our framework, we consider the possibility that dynamic representations may underlie creative processes. The dynamic properties of static form may influence both the generative and exploratory aspects of creative invention.

Consider the static patterns in figure 8.1. The isosceles triangle appears to point to the right. Even the equilateral triangle appears to point in one particular direction at any one time, although it is multistable over time (Attneave 1968). Attneave and later Palmer and Bucher (Palmer 1980; Palmer and Bucher 1982) investigated the basis of this multistability and found that cues that define the axis of symmetry seem to disambiguate the triangle. In this chapter we raise three related but different questions: (1) why do some static patterns, like triangles, point at all, (2) what does this phenomenon of "pointing" tell us about *mental representation*, and (3) what implications does our theory of representation have for creative thought? We propose that the phenomenon of pointing in perception is based on a perceptual interpretation of directionality and that this interpretation is implemented by a *dynamic mental representation* (Freyd 1987, 1993). After reporting on the results of experiments that provide support for this hypothesis, we consider the implications our theory of mental representation has for the role of dynamics in creative visual synthesis.

We conclude by suggesting that dynamic representations are the medium of creative visual synthesis. Following the Geneplore model of Finke, Ward, and Smith (1992), we consider the possibility that the

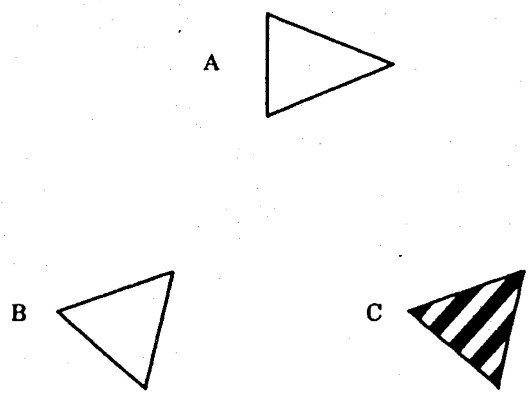

Figure 8.1
The isosceles triangle (*A*) appears to point to the right, in the direction of its smallest angle. The equilateral triangle without biasing cues (*B*) is ambiguous in direction of pointing. The equilateral triangle with axis-aligned stripes (C) appears to point to the right.

dynamic properties of static form may influence both the generative and exploratory aspects of creative invention. This possibility may help explain some of the subjective reports subjects make about their own creative processes. When interpreting "preinventive forms" during the generative phase of creative invention, for instance, subjects often report that they imagine using the forms or interacting with them in dynamic ways (Finke 1990). Some of this dynamic interaction may result directly from the dynamic mental representations underlying the perceived directionality of static forms.

Dynamic Mental Representations

We briefly describe an experiment on the mental representation of static patterns that led to the notion of dynamic mental representations. Freyd (1983) tested the hypothesis that the perception of still things, in this case photographs, might involve representation of dynamic information. In particular, people might perceive implicit motion when presented with pictures of frozen motion; in this case, perceiving implicit motion could mean the movement an object would undergo were it to be unfrozen. Using pairs of before-and-after pictures taken from action scenes, individual stills were presented to subjects tachistoscopically. Subjects were instructed to look at one picture and hold it in memory, and then to view a second picture and decide as rapidly as possible whether the second frame was same as

or different from the first. They were shown the pairs in either real order or backward order. Subjects took longer to indicate correctly that the second frame was different when the pair was in real-world temporal order.

Freyd's theory of dynamic representations has been heavily influenced by results from studies of representational momentum (Finke, Freyd, and Shyi 1986; Finke and Shyi 1988; Freyd and Finke 1984, 1985; Freyd and Johnson 1987; Freyd, Kelly, and DeKay 1990; Hubbard 1990; Hubbard and Bharucha 1988; Kelly and Freyd 1987; Verfaillie and d'Ydewalle 1991). In one representational momentum experiment, subjects were presented with a static figure in a sequence of orientations sampled from a possible path of rotation (Freyd and Finke 1985). Subjects were instructed to remember the third orientation they saw and were presented with a fourth orientation that was either the same as or different from the third. Test orientations were varied parametrically around "True-Same." Freyd and Finke found a generally symmetric unimodal distribution of "Same" responses centered not on True-Same but on a forward rotation from True-Same. That is, subjects showed a forward shift in memory for position.

Studies like these led Freyd to develop the idea that some mental representations might be dynamic. Toward the aim of specifying what a dynamic representation might be, she proposed two criteria, the first relevant for this chapter: a dynamic mental representation is one in which time is represented, using Palmer's (1978) terminology, "intrinsically." That means that time is represented with some of the same inherent structure as real-world time. For a representation to be dynamic, at least two aspects of the temporal dimension in the world must also be consequences of the inherent structure of the representing dimension: the temporal dimension must be directional, because time goes forward, and it must be continuous, because between any two points of time, another point of time exists.

We now propose that directionality is not only a necessary characteristic of dynamic representations but, more important, that perceived directionality depends on representational dynamics. Further, we theorize that perceived directionality depends on representational dynamics even when the directionality relates to a nontemporal dimension, such as a spatial dimension. Thus, we propose that the perceived directionality of a pattern depends on an underlying dynamic mental representation of it (Freyd 1987). In particular, we suggest that the representation of directionality for a given dimension is accomplished by representing change along that dimension in a particular direction. This suggestion leads to the hypothesis that memory for the position of a static pattern with clear directionality will be

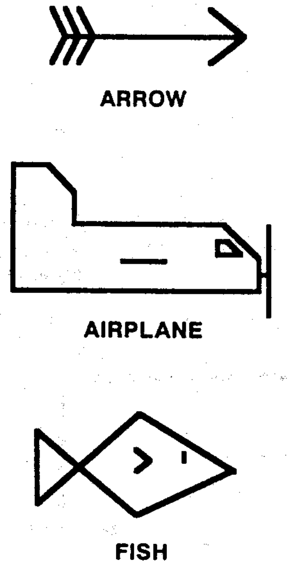

Figure 8.2
The stimulus patterns used in experiment 1

distorted in a predictable way: The remembered position will be further along the directional dimension, just as memory for position is distorted in the direction of implied motion in static photographs (Freyd 1983) and in representational momentum (Freyd and Finke 1984; Hubbard and Bharucha 1988; Kelly and Freyd 1987). Thus, if a pattern "points" rightward, we predict that memory for the position of the figure will be shifted to the right.

Experiment 1

Our goal for experiment 1 was to establish a memory distortion using a simple static pattern that conveys directionality. We also hoped to get some qualitative evidence that patterns varying in strength of directionality would result in memory shifts that were correspondingly weak or strong. We chose a rightward-facing arrow as our highly directional static pattern and also included two additional patterns, schematic drawings of a fish and an airplane, also rightward facing (figure 8.2).

In each trial subjects were presented with one of the three patterns, centered on the screen. After a 500-ms stimulus duration and a 750-ms retention interval, subjects were presented with the same pattern

in one of seven equally likely test positions. Three test positions were slightly to the left of center, three were slightly to the right of center, and one was centered. Subjects were asked to indicate whether the test position was the same as or different from the to-be-remembered pattern. Our dependent measure of interest was the number of same responses for each of the seven test positions. Since the arrow was rightward facing, we predicted that subjects would make more errors for arrows positioned to the right of center than to the left of center. We predicted similar but weaker asymmetry in the number of same responses for the fish and airplane.

Method

Subjects Eleven subjects recruited from the Cornell University community were paid for their participation in this experiment. Subjects in each of the experiments reported in this chapter were informed about the hypotheses and designs of the studies only after completion of the experimental session. No subject participated in more than one of the reported experiments.

Stimuli A computer-controlled vector-plotting HP graphics display screen was used to present stimuli. Figure 8.2 displays the three static patterns used in this experiment. Each pattern had a standard position, which was horizontally centered on the screen. Test positions consisted of identical patterns displaced horizontally −3, −2, −1, 0, 1, 2, or 3 mm to the right. The seven different test positions were presented equally often. The first pattern was always presented with a 500-ms stimulus duration, followed by a 750-ms retention interval in which the graphics screen was blank. The test pattern remained on the screen until the subject made a response. There were three pattern conditions corresponding to the three different static patterns. Test patterns were always the same shape as the to-be-remembered patterns and varied only in position on the screen.

Procedure Subjects were run individually in a session that lasted approximately 45 min. After reading an instruction sheet, each subject completed a block of 21 practice trials, followed by a block of 210 experimental trials. The block of 21 practice trials included one example of each trial type (formed from three pattern conditions in seven test positions). The block of 210 experimental trials was composed of 10 replications for each of the 21 trial types. Trials within each block were randomly ordered for each subject. Subjects, sitting at a comfortable viewing distance from the screen, initiated each trial by press-

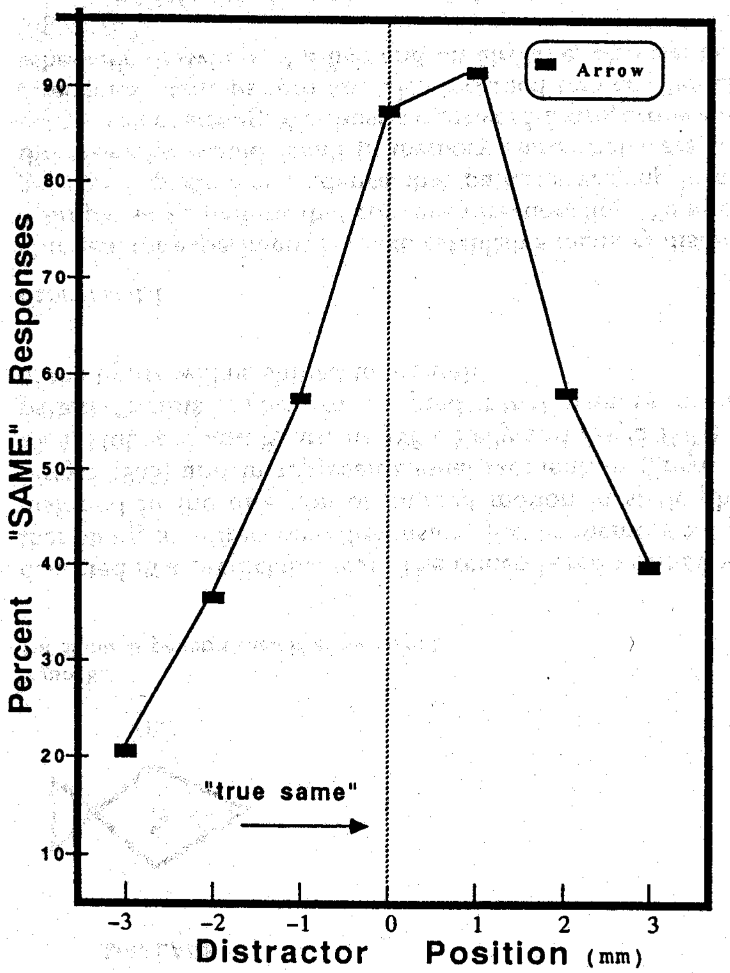

Figure 8.3
The mean percentage of "same" responses given for each distractor position plotted separately for each of the stimulus patterns used in experiment 1

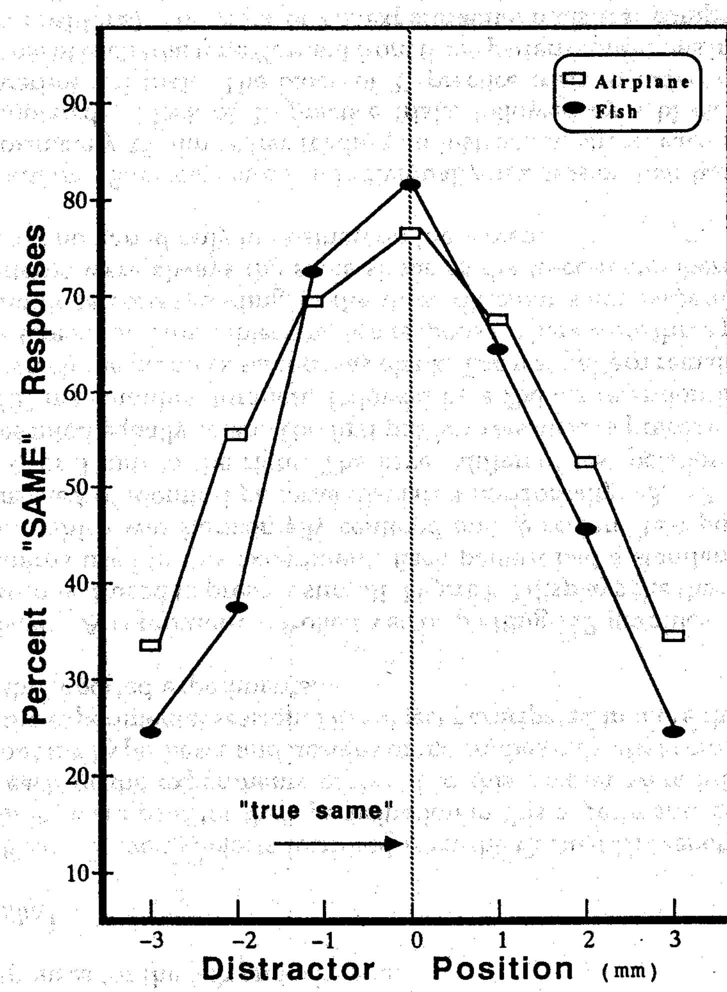

Figure 8.3
(continued)

ing a foot pedal and concluded each one by pressing one of two response buttons held in each hand (right for "same" and left for "different"). They were instructed to respond "same" only when the test position was exactly the same as the to-be-remembered position and encouraged to respond as quickly and accurately as possible.

Accuracy Criteria Data for individual subjects were first evaluated for overall accuracy. For all experiments reported in this chapter, we had preset accuracy criteria for individual subjects, established in order to increase the accuracy of our estimates of memory shifts. We required that the accuracy rate for the True-Same position by 50 percent or greater (averaged across all conditions) and that the mean accuracy rate combined for the two most extreme distractor positions be 50 percent or greater (also averaged across all conditions). For experiment 1 we excluded one subject for failing to meet the accuracy requirement.

Results and Discussion

Figure 8.3 displays the results averaged across subjects for each of the three pattern conditions. As predicted, subjects were more likely to respond "same" for arrow test positions that were to the right of center than those to the left of center. Indeed, there were more "same" responses for the arrow test position 1 mm to the right than for the True-Same position. No such asymmetry is apparent in the results for the fish and airplane patterns.

For the studies reported in this chapter, we did not use quadratic regression (Freyd and Finke 1985) to estimate individual subject shifts for use in significance tests. The regression analyses produced estimated memory shifts that were larger than the largest test position for a few subjects in a few experiments, because those subjects showed such a strong bias for the forward test positions. A parabolic fit for data in which the peak of the parabola is outside the range of the data is highly unstable. We therefore used an alternative method of estimating the memory distortions; following Faust (1990) we calculated arithmetic weighted means using the number of same responses for each test position. A shift of 0.0 would be expected if there was no memory distortion; a shift of -1.0 would correspond to 1 mm to the left; a shift of $+1.0$ would correspond to 1 mm to the right.

A one-way ANOVA using the weighted means revealed a main effect for pattern condition (arrow, fish, or airplane) ($F(2,18) = 11.05$; $p < .001$). We used t-tests to evaluate whether the weighted means were significantly different from 0 for each of the three pattern conditions. As predicted, the shifts were significantly to the right for the arrow ($t(10) = 4.14$; $p < .005$). Neither the airplane nor the fish pattern reached significance (t of less than 1.0 in both cases).

Experiment 2

Experiment 1 demonstrated that a rightward-pointing arrow induces memory shifts toward the right. We interpret these memory shifts as arising from a dynamic representation, such that memory for the arrow's position changes over time in the direction that the arrow points. In representational momentum experiments, memory shifts are induced by showing a figure in a sequence of static positions such that movement is implied. Our interpretation of the memory shift discovered in experiment 1 for a static arrow predicts that the directionality of a static pattern should influence the magnitude of memory shift if used in a representational momentum experiment. In experiment 2 we used the arrow in a representational momentum experiment to test the hypothesis that the memory shift should be greater when the arrow direction is consistent with the direction of implied movement than when the arrow direction is inconsistent with the direction of implied movement.

A drawback of experiment 1 is that leftward-pointing arrows were not presented to subjects. In experiment 2 we counterbalanced arrow direction as well as direction of movement.

Method

Subjects Twelve University of Oregon undergraduates enrolled in an introductory psychology class received credit toward a course research requirement by participating in this experiment. All subjects met the accuracy criterion (as described for experiment 1).

Apparatus and Stimuli The apparatus was the same as in experiment 1. The stimuli were arrows presented in a sequence of three positions such that horizontal movement was implied by the sequence. In the Consistent condition, the arrow direction and the direction of implied movement were the same (for half the trials, the arrow pointed left and the direction of implied motion was left; for the other half of the Consistent trials, the arrow pointed right and the direction of implied motion was right). In the Inconsistent condition, the direction that the arrow pointed was at odds with the movement implied by the sequence of positions (for half the trials, the arrow pointed to the left and the implied movement was to the right; for the other half of the

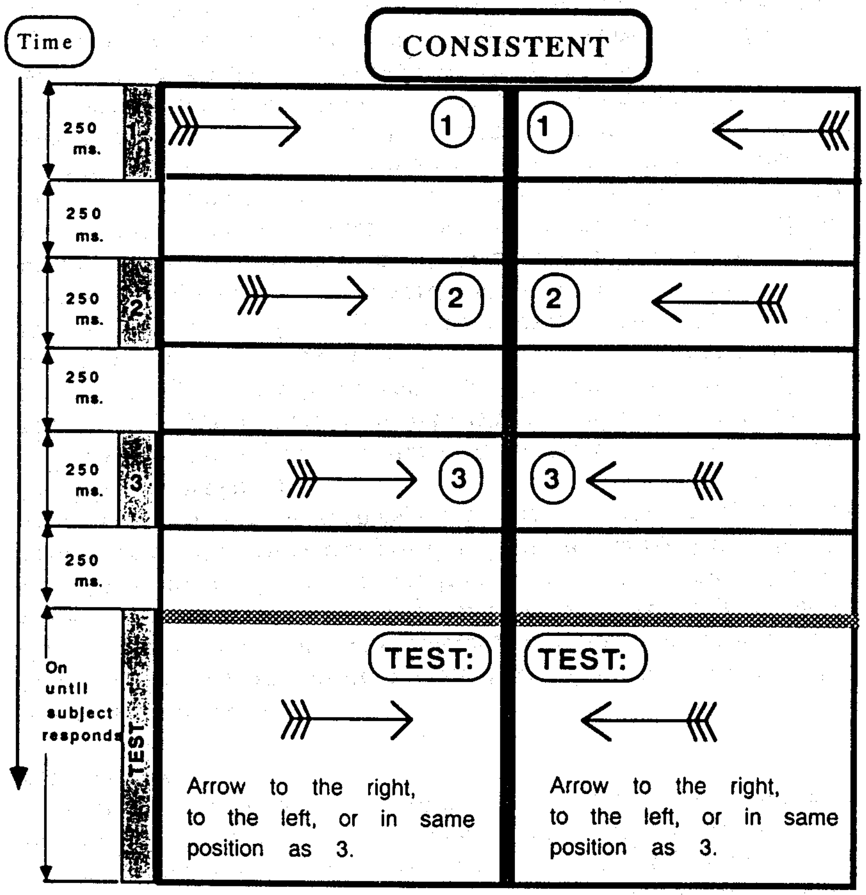

Figure 8.4
Schematic depictions of the Consistent and Inconsistent conditions used in experiment 2

Inconsistent trials, the arrow pointed to the right and the implied movement was to the left). The stimuli are depicted in figure 8.4.

The rightward arrow was the same as the arrow used in experiment 1. The leftward arrow was a mirror reflection of the rightward arrow. Each arrow was presented in three positions on the screen, followed by a test position. The third position was always centered on the screen. For movement to the right, the first position of the arrow was 2.6 mm left of center. The second position was 1.3 mm left of center. For movement to the left, the arrow was presented

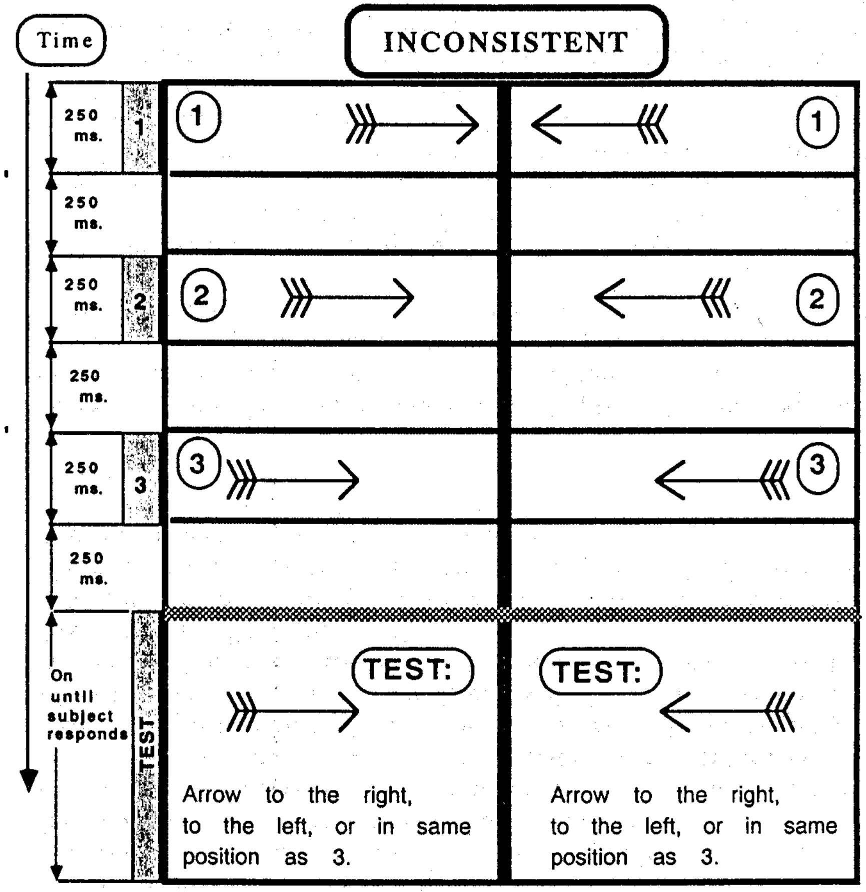

Figure 8.4
(continued)

2.6 mm right of center, followed by 1.3 mm right of center. The seven test positions were the same as those used in experiment 1.

The first three arrows were presented with 250-ms stimulus durations, separated by 250-ms interstimulus intervals. The retention interval between the third arrow and the test position was 250 ms. The test arrow remained on the screen until the subject made a response.

Procedure Subjects completed a practice block of 28 trials and then a block of 280 experimental trials, formed from 1 replication and 10 replications, respectively, of each of 28 trial types. The 28 trial types

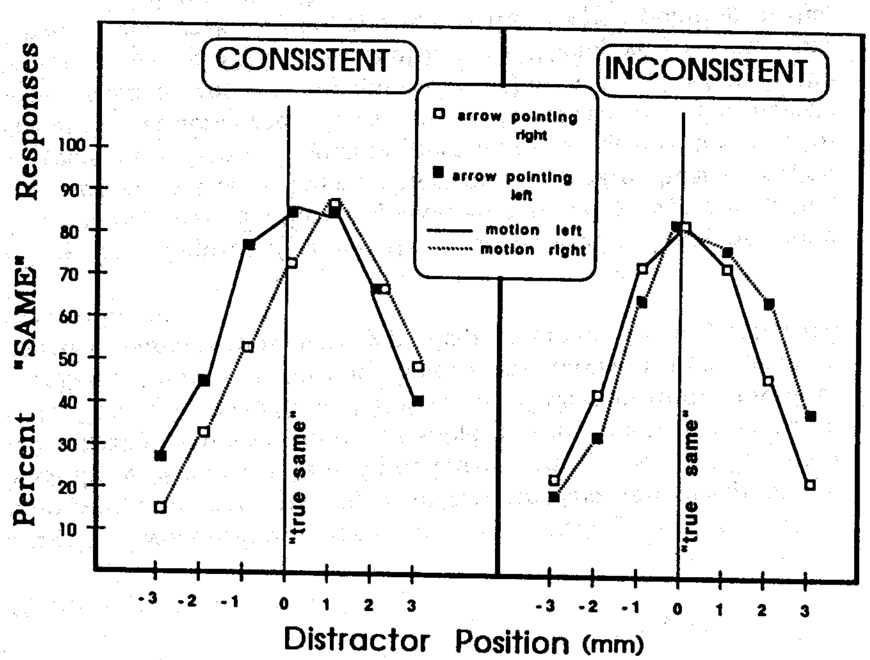

Figure 8.5
Results for experiment 2

were composed of two consistency conditions (Consistent or Inconsistent), each of which had two nested conditions such that the direction of implied motion and the direction that the arrow pointed were counterbalanced times seven distractor positions. The 28 practice trials and the 280 experimental trials were randomly ordered for each subject.

Accuracy Criteria We applied the same accuracy criteria as described for experiment 1. All 12 subjects met the criterion for experiment 2.

Results and Discussion
Figure 8.5 displays the percentage of "same" responses for the Consistent and Inconsistent conditions, averaged across subjects. Positive distractor positions are in the direction of the implied movement; negative distractor positions are in the opposite direction. Combining across all conditions there was a significant shift of +.29 mm ($t = 3.10$; $p = .01$). In other words, we found a significant representational momentum effect.

As predicted, when the directionality of the static pattern is consistent with the implied movement, the magnitude of the memory shift is greater than when the directionality of the static pattern is inconsistent with the implied movement. Averaged across subjects, the estimated memory shift of .39 mm for the Consistent trials is significantly larger than the shift of +.19 mm for the Inconsistent trials ($t(11) = 1.99$; $p = .036$, one-tailed). This means that, as predicted, the static configuration of the stimulus (the arrow direction) affected the magnitude of the memory distortion induced by the movement implied by a sequence of positions.

In experiment 1 we found that memory for the position of a rightward-pointing arrow was distorted to the right. In experiment 2 we used arrows in a representational momentum paradigm and found that when the arrow's directionality was consistent with the implied motion, the memory shift was greater than when the arrow's directionality was inconsistent with the implied motion. We interpret these results as supportive of our hypothesis that the perceived directionality of static figures is based on a dynamic mental representation.

Experiment 3

One limitation of the first two experiments is that the stimulus pattern used, an arrow, has a conventional meaning that may evoke a dynamic representation. Specifically, arrows are often used to indicate movement in a particular direction. In experiment 3 we attempted to generalize our claim about the directionality of static forms by using patterns that do not have a conventional meaning related to movement: an equilateral triangle and three isosceles triangles varying in width (figure 8.6). Attneave (1968) noted that at any one moment, an equilateral triangle appears to point in a particular direction, although the directionality is multistable. Later, Palmer (1980; Palmer and Bucher, 1982) discovered that the addition of stripes inside the triangle biases the particular interpretation of directionality. If the stripes are orthogonal to one side of the triangle, the triangle appears to point in the direction defined by the axis of symmetry.

In experiment 3 we looked for a relationship between the pointedness of a triangle and magnitude of the memory shift. We varied pointedness by varying the narrowness of the triangle. We assumed that the narrower the triangle, the more it would seem to point. (This assumption would break down as the triangle became so narrow as to appear as a straight line.) We used the four triangles displayed in figure 8.6 in two tasks. In the rating task, subjects were asked to indicate in which direction each triangle pointed and then to give a

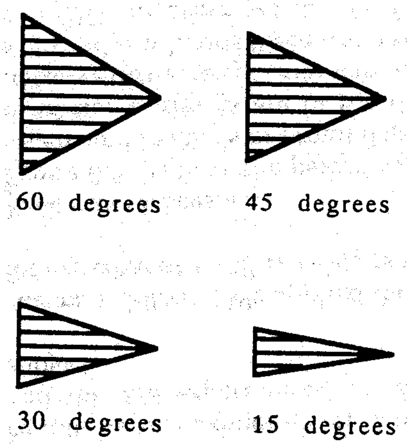

Figure 8.6
The 60-, 45-, 30-, and 15-degree triangles used in experiment 3

rating from 1 (barely pointing) to 10 (strongly pointing). For the memory task, a different group of subjects were given the standard Same-Different task.

Method

Subjects Twenty-nine members of the University of Oregon community volunteered to participate in the rating task used in experiment 3. Of those 29 subjects, 12 had previously participated in a pilot study using triangles; the remaining 17 subjects were completely new subjects. Twenty-five additional University of Oregon undergraduates enrolled in an introductory psychology class received credit toward a course research requirement by participating in the memory task used in experiment 3.

Rating Task Figure 8.6 shows the triangles used in both the rating and memory tasks. For the rating task, each triangle was printed (using a computer-controlled laser printer) on a separate sheet of paper. Subjects were then individually presented with each of the four triangles in a random order. Upon presentation of each triangle, subjects were asked to answer two questions: (1) In what direction is the triangle pointing? (2) On a scale of 1 to 10 (10 being very strongly and 1 being very weakly), how strongly is the triangle pointing in that direction? Subjects gave their responses verbally.

Memory Task The apparatus was the same as in experiments 1 and 2. On each trial, subjects were presented with one of four triangles for 250 ms, followed by a 500-ms retention interval, followed by the same pattern in one of nine test positions. The four triangles (60, 45, 30, and 15 degrees) are displayed in figure 8.6. The vertical edge of the triangles was centered on the screen. The nine test positions ranged from -4 to 4 mm in 1-mm steps around the True-Same position. Subjects were run individually. After reading an instruction sheet, each subject completed a block of 36 practice trials, followed by a block of 540 experimental trials. The block of 36 practice trials included one example of each trial type (formed from four pattern conditions in nine test positions). The block of 540 experimental trials was composed of 15 replications for each of the 36 trial types. Trials within each block were randomly ordered for each subject. All other aspects of the procedure were the same as for experiments 1 and 2.

Accuracy Criteria We applied the same accuracy criteria as we had for experiments 1 and 2. To our surprise, only 17 of the 25 subjects we tested met the criteria. Because these criteria were preset, we will report results for only these 17 subjects. However, because we were concerned about disregarding the data from so many subjects, we also performed a complete set of statistical tests on the data for all 25 subjects. The results were qualitatively the same for the larger group of subjects as for those who met the accuracy criterion. More important, all results that were significant in one case were also significant at approximately the same level in the other.

Results and Discussion

Rating Task We first considered the responses to question 1 about the direction each of the four triangles appeared to point. All 29 subjects indicated that they thought the 45-, 30-, and 15-degree triangles pointed to the right. Twenty-six subjects indicated that the 60-degree (equilateral) triangle pointed to the right. One subject was not sure in which direction the 60-degree triangle pointed; one subject indicated that he thought that the 60-degree triangle pointed down; and the remaining subject indicated that it pointed up.

We next considered the responses to question 2 about the degree to which the triangle pointed in a given direction for the 26 subjects who indicated that all four triangles appeared to point to the right. Figure 8.7 shows the average rating for each of the four triangles. We performed a two-way ANOVA in which subject experience was a be-

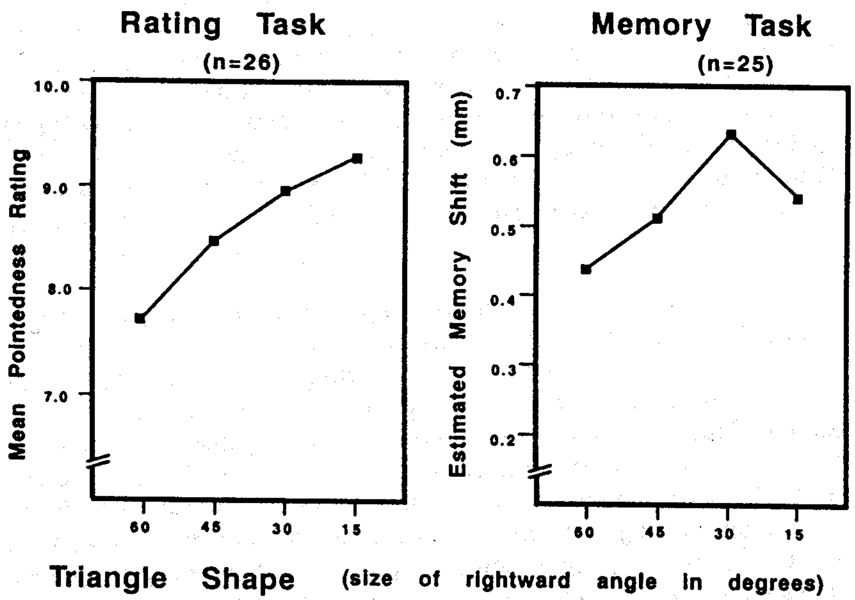

Figure 8.7
Results for experiment 3

tween-subject factor with two levels (10 subjects were previously in a pilot study using triangles and were thus considered experienced; 16 subjects were inexperienced), and triangle shape was a within-subject factor with four levels. The ANOVA revealed no main effect of subject experience ($F(1,24) = .005$; $p = .95$) and no interaction between subject experience and triangle shape ($F(3,72) = .65$; $p = .59$). As predicted, however, triangle shape led to significantly different pointedness ratings ($F(3,72) = 13.81$; $p < .001$).

Memory Task Figure 8.7 also displays the average weighted means for the memory task for each of the four triangles. Memory for the position of the triangles was significantly shifted rightward for each of the four triangles, including for the 60-degree (equilateral) triangle ($t(16) = 2.08$; $p < .05$, one-tailed). A one-way ANOVA revealed a main effect for triangle shape ($F(3,48) = 3.91$; $p < 0.05$).

The fact that there was a significant shift for the equilateral (60-degree) triangle is important because it is the least arrow-like of the four triangles and thus the triangle for which it seems especially unlikely that any shifts in memory depend on a conventional interpretation of the stimuli. However, one limitation of experiment 3 is that the predicted memory shifts for the triangles were all toward the right. Perhaps shifts to the right reflect a tendency to misremember the position of triangles toward the right, independent of the biasing cues. In a separate experiment we used identical stimuli to those used in experiment 3 except that the triangles had no internal stripes to bias direction of pointing. Thus, the 60-degree triangle was an ambiguous equilateral triangle (Attneave 1968). If there is a general tendency to misremember objects to the right, we should see some indication for rightward shifts with these stripeless triangles. Fifteen additional subjects participated. The procedure was the same except that the retention interval was 250 ms instead of 500 ms. The shifts we measured were negative (−0.16, −0.25, −0.26, and −0.11, for the 60-, 45-, 30-, and 15-degree triangles, respectively), that is, toward the left but not significantly so. A one-way ANOVA revealed no significant effect for triangle shape ($F(3,42) = 1.46$; $p > .20$), suggesting that without the biasing stripes, even the isosceles triangles are fairly ambiguous pointers.

In this experiment we found that memory for the position of an equilateral triangle is shifted in the direction it appears to point. This finding can be compared with a study by Bucher and Palmer (1985) in which they attempted to bias perceived pointing of an equilateral triangle by showing the triangle moving in a particular direction. They hypothesized that movement could define an axis of symmetry, which would then determine the direction of pointing, and found that movement aligned with the axis of symmetry (that is, parallel to a possible direction of pointing) effectively biased pointing, but movement aligned with a side of the triangle (that is, perpendicular to a possible direction of pointing) produced no such effect. Further, for the axis-aligned movement, pointing was more effectively facilitated in the same direction of motion than in the reverse direction of motion, which they interpreted as a response-compatibility effect. In other words, Bucher and Palmer's strongest biasing condition was exactly the same direction of motion that we find predicts shifts in memory for position of a static triangle. They argued that their results were consistent with the hypothesis that symmetry determines perceived pointing; we suggest that their results are also consistent with our interpretation of the phenomenon of pointing (and these interpretations are not mutually exclusive): that it depends on an underlying dynamic mental representation.

General Discussion

Summary

In experiment 1 subjects were asked to look at a rightward-pointing arrow, a static pattern that has compelling directionality, and after a brief retention interval were asked to make a same-different judgment. The same arrow was presented in one of seven locations centered around True-Same. We found a clear shift to the right, the direction in which the arrow points. Based on the results from experiment 1, we wondered whether the directionality of the static arrow was powerful enough to affect the memory shift induced by a standard representational momentum paradigm. We tested this possibility in experiment 2 by comparing trials in which the direction of the arrow was consistent with the direction implied by the sequence of positions with inconsistent cases in which the static configuration was at odds with the direction implied by the sequence of positions. We found that the directionality of the arrow had a clear and strong effect on the magnitude of representational momentum, suggesting that both the directionality of the arrow and the implied movement in representational momentum tap into the same dynamic representation. In experiment 3 we looked for a relationship between the pointedness of a triangle and the magnitude of the memory shift. We varied pointedness by varying the narrowness of the triangle. The results from a rating task verified our assumption that the narrower the triangle was, the more it appeared to point. Results from the memory task were also consistent with this assumption, in that the shifts were generally larger for the narrower triangles. We found a significant shift even for the equilateral triangle. Thus, even with a stimulus that has no known semantic association with movement, we nonetheless see a memory shift consistent with an underlying dynamic representation.

Implications for Aesthetics

These three experiments go beyond our previous work on the dynamics of static forms because we used static patterns that do not imply, in any obvious way, real-world dynamics. In comparison, Freyd's (1983) study investigating memory for photographs used stimuli that were specifically chosen because an action was frozen in the snapshot. Similarly, the representational momentum experiments (Freyd and Finke 1984; Kelly and Freyd 1987) all used a sequence of static positions sampled from a possible real-world transformation. Even the studies by Freyd, Pantzer, and Cheng (1988), looking at memory for highly stable scenes, employed a depiction of the disruption of equilibrium to induce a memory shift.

The proposal that static form alone, without virtue of representing likely real-world transformations, can induce a representation of dynamics is compatible with a theory of visual aesthetics proposed by Arnheim (1974, 1988). Arnheim (1988) points out, for instance, that Matisse's *La Danseuse* (which does not directly represent a common object or scene) manages through form alone to create a powerfully dynamic image. We predict that where Arnheim notes dynamics in art, most observers would more readily experience directionality, or even "pointing," within the static picture. We also predict that where Arnheim notes dynamics in static art, observers have systematic shifts in memory for position of the form in the direction of pointing. Freyd (1993) hypothesized that memory shifts occur in between recurring eye fixations on points of dynamic interest such that the observer is repeatedly experiencing representational surprise at the discrepancy between the remembered and the experienced reality of a dynamic element. In turn, this representational surprise might relate to aesthetic excitement. McKeown and Freyd (1992) have confirmed that memory shifts can occur for static art.

Dynamic Representations as Medium for Creative Cognition

While creative artists exploit the potential to invoke a dynamic representation with static art, dynamic representations likely have an even more general role in cognition and creative cognition. Finke, Ward, and Smith (1992) suggest that the study of basic cognitive processes and of creativity are naturally interdependent pursuits. Our consideration of dynamic representations would thus inform the investigation of creative cognition by establishing foundational aspects of mental representation. Specifically, we propose that dynamic mental representations are employed during creative thought. At the same time, creative processes may ultimately shape the direction of the dynamic representations. For instance, creative cognition might determine the *path* of motion (Finke and Freyd 1989).

Finke, Ward, and Smith (1992) propose the Geneplore model of creativity, which consists of two processing stages: a *generative* phase, in which mental representations called "preinventive structures" are constructed, followed by an *exploratory* phase, in which these structures are explored for possible interpretations. Finke, Ward, and Smith (1992) apply this model to a variety of domains of invention, including visual synthesis. We suggest here that the dynamic properties of static objects will have an important role in both the generative and exploratory phases of creative invention.

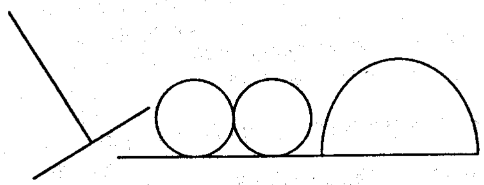

Figure 8.8
A pattern (croquet) created from the letter *T*, the number *8*, and the letter *P* in an experiment on creative visual synthesis (Finke and Slayton 1988). We suggest that the angle of the *T* implies movement, which helps define the *T* as a croquet mallet; this illustrates the potential role of dynamics in creative visualization and interpretation.

Generative Phase We propose that if components such as preinventive structures are highly directional, this will lead, first, to a greater ease of mental synthesis. If the components are dynamic, they may lend themselves more easily to movement and other transformations. Second, it will lead to constraints on creative combinations. For instance, some combinations might be more likely than others due to the inherent dynamics of the stimuli. Finke (1990) has noted that when they interpret preinventive forms, subjects often report that they imagine using the forms or interacting with them in dynamic ways, in order to gain insight into how best to interpret the forms. Some of this dynamic interaction may result directly from the dynamic mental representations underlying the perceived directionality of static forms.

Exploratory Phase Just as pattern goodness affects how easily one might recognize an emergent pattern in imagery (Finke, Ward, and Smith 1992, p. 53), the emergent dynamic properties of creative combinations may influence interpretation. Consider the creative visual synthesis produced by a subject in Finke and Slayton (1988), illustrated in figure 8.8. Would the subject's interpretation of the pattern as depicting the game of croquet have been as likely if the mallet were in a stable position? In other cases, the nature of the dynamics might suggest particular interpretations by virtue of knowledge of kinds of motion. For instance, aspects of directionality and pointedness may suggest animacy (Freyd 1992). Animals are directional; they tend to move in the direction in which they point. Freyd and Miller (1992) have shown that representational momentum shifts are greater for animate-appearing shapes moving in a forward direction than for the same shapes moving backward. Knowledge of likely motion based on static shape, whether croquet mallet or animal, is likely to inform creative interpretation.

At a more abstract level, we speculate about some of the ways that dynamic representations may shed light on creative process.[1] Many creative ideas have an apparent dynamic quality; they flow forward in time, constantly evolving and revealing new implications. They seem to have a conceptual momentum all their own. Most of these ideas seem to move more naturally in certain conceptual directions than others. Further, once they emerge, creative ideas often mask earlier ideas and beliefs. This may be analogous to the way memories for previous positions are pushed forward in time. In other words, the creative process may have a kind of directionality to it, with consequences somewhat like those for the temporal directionality of representational momentum; there is, in some sense, no going back to an earlier state. Fiction and poetry writers, filmmakers, and composers may well exploit this sort of conceptual momentum, just as painters may exploit the more perceptual processes of dynamic representations and representational momentum. The observer of the artistic creation is, in essence, expected to extrapolate into the future from any given point in the creative product, and thus artists' job is, in part, to invoke creative processes in the observer.

Future Research and Conclusion

The results reported here suggest a number of research directions. In future studies, researchers could vary the dynamic nature of the component parts used in mental constructions to test the role of dynamics in the generative phase of creative thought. Similarly they could examine the role of implied dynamics in arriving at novel pattern interpretations in the exploratory phase of creative discovery. Eventually it would be interesting to extend this line of research to nonvisual forms of creative cognition.

An additional direction for future research is to investigate the role of directionality in other sorts of patterns. A possibility we have considered is to use ambiguous patterns such as the duck-rabbit pattern shown in figure 8.9. It would be interesting to determine if subjects would misremember the position of the pattern in a direction consistent with the interpretation they have for the pattern. That is, if the pattern appears to be a rabbit, we would predict a memory shift in the direction the rabbit seems to be facing, but vice versa for the duck. This also raises the possibility that underlying dynamics may play a role in the interpretation of ambiguous figures.

In the meantime, our results are supportive of the hypothesis that perceived directionality is based on a dynamic representation. This is further evidence for the critical role of time in mental representation. To the extent that dynamic representations are fundamental to every-

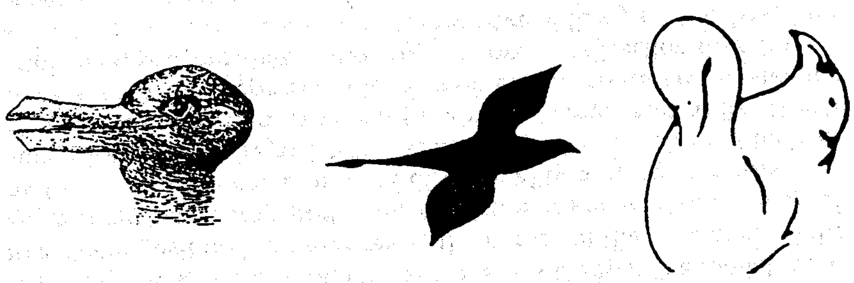

Figure 8.9
Three ambiguous patterns (from left to right: duck/rabbit, goose/hawk, duck/squirrel) that change directionality with interpretation

day cognition, we would expect to learn that dynamic representations are fundamental to creative thought (Finke, Ward, and Smith 1992). In particular, the dynamic properties of mental representation may influence both the generative and exploratory aspects of creative invention.

Notes

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1. We are indebted to the editors of this book for their creative suggestions captured in this paragraph.

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