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Visual Intelligence and Analogical Thinking

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VISUAL INTELLIGENCE AND ANALOGICAL THINKING

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One of the most famous stories of scientific creativity concerns the chemist Friedrich von Kekule, who worked in the latter half of the 19th century. In 1865, Kekule was attempting to infer the internal structure of the benzene molecule. He knew that it was composed of six carbon atoms and six hydrogen atoms, but he was finding it very difficult to visualize how these atoms were arranged. His working assumption, that the atoms were lined up in rows, was incompatible with other known facts about carbon and hydrogen. One evening, after much puzzling over this problem, Kekule sat in a chair by his fireplace and dozed. Strings of atoms appeared before his eyes, and they began to twine and twist like snakes. And then, suddenly, one of the snakes reared back and seized on its own tail. At that instant, Kekule awoke with the solution to his problem immediately clear: as subsequent research confirmed, the structure of benzene is based on a string of six carbon atoms arranged in a circle (Findlay, 1965, p. 39).

This story has often been used as an illustration of the crucial role that visual images have played in the development of human knowledge. In Kekule's case, the images were purely internal, products of his "mind's eye." However, as a growing body of scholarship has demonstrated, the advance of science and technology has also been affected critically by the various visual media that people have used for recording the appearance of external reality. This point is the principal conclusion of William Ivins' (1953) influential history of woodcuts, engravings, and other early techniques for the exact reproduction of pictures. According to Ivins, the development of these techniques acted as a stimulus for several fields of knowledge, such as botany, whose progress had been impeded by the lack of means for the exact transmission of visual information. Similarly, in a recent detailed examination of the interplay between art and science in the Renaissance, Edgerton (1991) argues that both architecture and engineering were affected profoundly by the 15th-century invention of

linear perspective, which made it possible to create accurately scaled previsualizations of the appearance of three-dimensional structures. Indeed, as Edgerton had demonstrated in an earlier study, the first person to use linear perspective in a picture was most likely an architect, Filippo Brunelleschi (Edgerton, 1975).

Both Ivins and Edgerton, as well as other writers who have dealt with these matters, make a further point that is particularly relevant to the concerns of educators. They argue that, in addition to serving the purposes of specific scientific or technical tasks, visual media also contribute to the development of human intellect by enhancing their users' mental skills. This idea has become familiar to many educators through the well-known writings of Howard Gardner (1983, 1993), who has made the more general point that there are several distinct forms of intelligence, each of them related to particular modes of human communication. Gardner's discussion of visual media focuses on their connection to spatial intelligence, a set of mental skills having to do with the perception and comprehension of two- or three-dimensional shapes, objects, and relationships. Spatial intelligence is also the focus of Edgerton's and Ivins' writings. However, there is at least one other type of intellectual aptitude that has been associated with visual media, namely, analogical thinking (Hargittai, & Hargittai, 1994; Whittock, 1990). This aspect of visual intelligence will be the focus of the present chapter.

THE NATURE OF ANALOGICAL THINKING

Analogical thinking is the type of mental process illustrated by Kekule's vision of the snake biting its tail. In a detailed discussion of this story, Margaret Boden (1991, pp. 100, 101) pinpoints the essential features of that process: the ability to discern some structural similarity between two different

objects, events, or situations, and to get a better understanding of one of them on the basis of the characteristics of the other. In Kekule's case the image of the snake twisting itself into a circle gave him the idea that the line of carbon atoms in the benzene molecule could also twist itself into a closed loop. As Boden demonstrates, similar leaps of mind are central components of creative thinking not only in the sciences but also in the arts. The role of analogical reasoning in scientific discoveries has also been documented by John-Steiner (1985) and Mitchell (1993, p. 7), while Vosniadou and Ortony (1989, p. 1) have argued that analogy is "one of the most fundamental aspects of human cognition." A related belief in the significance of analogical thinking for educational attainment is reflected in the inclusion of analogy items in such standardized tests as the GRE (Bejar, Chaffin, & Embretson, 1991).

The important role that analogy can play in visual media is perhaps most evident in the case of informational displays. Boden (1991, p. 101) notes that maps, diagrams, scale models, and family trees are all instances of analogical representation. Detailed demonstrations aimed partly at visual educators of the informational uses of visual analogy have been provided by Edward Tufte (1983, 1990). For example, Tufte discusses a classic chart that he says "may well be the best statistical graphic ever drawn" (1983, p. 40). Created in 1861 by the French engineer Charles Joseph Minard, this chart displays the fate of Napoleon's army during its disastrous invasion of Russia in 1812–13. The line that plots the army's direction of travel across a map of Poland and Russia starts out thick and then gets progressively thinner as Napoleon's men begin to die off. When the line reverses direction and traces the path of Napoleon's retreat, it becomes linked to a scale indicating the plummeting temperatures that reduced the army's size even further. All of the correspondences between this chart and the reality that it represents—the thickness of the line and the size of the army, the line's path across the page and the army's direction of travel, the downward-pointing scale and the falling temperatures—are examples of analogical representation.

Although the analogical aspects of visual media may be particularly clear in the case of informational displays, analogy is also a significant feature of the more purely artistic uses of visual images. An illustration of visual analogy in an artistic context is provided by Rudolf Arnheim (1969, pp. 120–129) in a discussion of a class exercise requiring students to draw abstract pictures of a good marriage and a bad marriage. One of Arnheim's students drew two circular figures, the first one consisting of smoothly curving lines, the second of spikes. Another student drew a pair of interlocking yin-yang figures and contrasted that with a pair of figures separated by some distance. In other words, both students' drawings are based on implicit analogies between the properties of visual shapes—smoothness versus roughness; closeness versus distance—and the abstract characteristics of human activities or relationships. Arnheim suggests that such connections are at the heart of the process by which abstract visual designs are able to evoke meaning. Furthermore, it can be argued that similar connections account for a significant part of the meaning of representational art as well (e.g., see Arnheim, 1954,

pp. 425–443; Messaris, 1994, pp. 40–44; Zettl, 1990). The following pages contain a closer look at these aspects of visual analogy. The discussion begins with an examination of the composition of individual images and then goes on to consider the consequences of juxtaposing two or more images, either in movie sequences or in complex static displays.

VISUAL COMPOSITION

As indicated above, the analogical basis of visual composition has been explored by several writers. For pedagogical purposes, a particularly useful introduction to the topic is provided by Molly Bang (1991) in a book which is ostensibly aimed at young children but nevertheless contains a systematic theoretical treatment of its subject. Drawing on her professional background as a prominent illustrator of children's books, Bang frames her presentation as a step-by-step examination of the stylistic decisions involved in the creation of a single picture, *Little Red Riding Hood stalked by the wolf in the forest*. This discussion entails such simple questions as whether the wolf's features should be pointed or curved and whether its eyes should be red or mauve, but the discussion's culmination is a set of general principles accounting for the meanings of individual design elements (shapes, sizes, colors, etc.) and the relationships among them. The central premise underlying all these principles is that viewers respond to the abstract features of visual composition on the basis of unconsciously perceived analogies to elements of real-world experience. As Bang puts it:

This word *associate* is the key to the whole process of how picture structure affects our emotions. . . . We associate pointed shapes with real pointed objects. We associate red with real blood and fire. Specific elements such as points or color or size seem to call up the emotions we felt when we experienced actual sharp points or colors or noticeably large or small things. (p. 102)

Similar assumptions about the meaning of visual composition can be found in the work of other practicing artists. Among painters in the Western fine-arts tradition, an especially noteworthy investigator of these matters was Georges Seurat, who eventually developed an explicit theory that parallels Bang's in its essential details (Homer, 1964; Lee, 1990). For instance, he believed that a wedge-like shape pointing toward the top of a canvas would evoke both dynamism—because of the association with the properties of knives or other sharp-edged objects—and buoyancy—because of the association with upward movement in general. Consequently, in his rendition of scenes in which these qualities were an appropriate part of the tone he was trying to convey, Seurat would incorporate upward-pointing wedge shapes in the composition even when that meant sacrificing some of the naturalistic appearance of the image. As Homer (pp. 220–234) has noted, this practice is evident in such paintings as "*Le Cirque*" (1891) and "*Le Chahut*" (1890), in which upward-pointing tapers are added to the facial features of a circus acrobat, in the former case, and a line of high-stepping dances, in the latter.

In recent years, the assumptions underlying practices of this sort have been tested experimentally by such researchers as Hartmut Espe, whose work deals with advertising and industrial design. In Espe's experiments, viewers are shown pictures of abstract two- or three-dimensional objects and asked to indicate what meanings these objects express. One of Espe's studies investigated viewers' responses to three kinds of shapes: angular (triangle, star), orthogonal (square, rectangle), and curved (circle, ellipse). Viewers were asked to rate these shapes on two dimensions of meaning: how powerful and how active they appeared. Espe's assumption about the angular shapes was very much the same as Bang's and Seurat's: by analogy to the properties of real-world angular objects (wedges, knives, etc.), he expected these shapes to be seen as both powerful and active. For reasons that should be equally apparent, he expected the orthogonal shapes to be rated powerful but inactive, and the curved shapes to be rated neither powerful nor active. All these expectations were confirmed by the experimental results, which can therefore be seen as providing empirical support for the theoretical approach represented by Bang, Seurat, and scholars like Arnheim. Espe has also found, however, that the role of analogy in visual interpretation can be affected critically by context. For example, when viewers are shown a circle in a context that makes it appear three-dimensional instead of flat, the ratings of activity and power go up, perhaps because it is now seen as analogous to a ball, with connotations of sports.

The kinds of visual analogies investigated by Espe and illustrated in the examples from Bang and Seurat are relatively simple in the sense that they involve actual physical similarities between elements of a visual design and objects in the real world. For educational purposes, examples such as these may be the most convenient means for introducing the concepts of analogical representation to students. It would be a mistake, however, to assume that the analogical meanings in real works of art can always, or even frequently, be accounted for in such direct terms. A crucial feature of analogical thinking in art is its capacity to evoke meaning on the basis of purely conceptual parallels between the formal properties of a picture and the structural characteristics of some aspect of real-world experience. This was the case in the examples cited earlier from Arnheim, whose students were able to give visual form to the emotional qualities of marital relationships. The connection between visual education and the enhancement of intelligence seems especially clear in such instances.

The use of visual analogy for the sorts of complex purposes illustrated by Arnheim has been examined cross-culturally in a series of related studies. This body of research began with an investigation by Fischer (1961), an anthropologist concerned with the art of traditional, preindustrial cultures. Fischer was interested in the possibility that there might be an analogical connection between the stylistic features of a society's visual arts and the broader cultural values of that society. More specifically, he assumed that the relationships among design elements in a society's artworks might mirror the society's prevailing patterns of social relationship. For example, equality in a society's interpersonal relationships might be reflected by symmetrical compositions in a society's art, while the

presence of rigid distinctions among the members of a society might be reflected in its art by distinct boundaries around the compositional elements. Fischer tested these assumptions with a sample of some 30 traditional cultures, such as the Ashanti, Balinese, and Navajo, from various parts of the world. The results of these tests strongly supported his theory. Furthermore, similar findings have since been reported by researchers working with other cultures (e.g., Dressler, & Robbins, 1975; Hatcher, 1988; Pocius, 1979). Taken together, these findings suggest that educating students about visual analogy in art may also give them a new window into other people's cultural values.

POINT OF VIEW IN VISUAL ART

The aspects of composition that have been examined up to this point have to do with the arrangement of design elements on the surface of the image. The time has now come to turn to a different type of compositional device in which analogical connections also play a major role. This device has to do with the point of view from which the image is presented to the viewer. In other words, what is at stake with this device is the viewer's placement relative to the people or places in a picture: close-up or more distant, eye-level or at an angle, and so on. The analogical basis of point of view has been analyzed in detail by Meyrowitz (1986), who argues that people respond to this device by analogy to the ways in which they respond to interpersonal distance and orientation in real-world social relationships. For example, since proximity in real life is related to intimacy and involvement, a close-up in an image should elicit relatively greater engagement from the viewer. Similarly, since bigger people are often stronger than smaller ones, a view from below may make the person in an image appear more powerful in the eyes of the spectator.

Point of view is an important compositional device in drawing, painting, and photography, as well as film and video camerawork. Indeed, in fictional movies the distance between the camera and the subject is one of the principal visual means for such effects as heightening the intensity of a scene as it moves towards its climax, maintaining the viewer's sympathy with the hero and emotional distance from secondary characters, or releasing the tension of the movie following the resolution of the action. Nevertheless, despite its importance in these and other situations, the potential uses of point of view often seem to be overlooked when nonprofessionals make pictures. Studies of amateur filmmakers and of young people learning to make movies find that both groups tend to record the action from a single, unvarying perspective (Chalfen, 1982; Griffin, 1985). It appears, therefore, that there is considerable scope for visual education in this area. Moreover, in view of the analogical connection between everyday social interactions and the uses of point of view in the visual media, it is conceivable that learning how to employ this compositional device effectively may have the additional consequence of strengthening students' real-world perspective-taking skills.

Yet another reason why visual educators might want to focus on point of view has to do with the political and

advertising applications of this device. There is considerable evidence that manipulations of point of view can be effective instruments of visual persuasion in commercial advertisements and in political imagery. At the same time, though, there is reason to believe that viewers tend to overlook these manipulations. Consequently, drawing students' attention to point of view could contribute to the development of informed, critical attitudes toward potential influences of the visual media. Some indication of the need for this form of visual education comes from an experiment by Mandell and Shaw (1973) concerning the use of low camera angles in political imagery. This convention has a long history, especially—though by no means exclusively—in totalitarian political regimes. In Mandell and Shaw's study, college students were asked to make judgments about a political figure appearing in a newscast. There were three versions of this person's image: one taken at eye-level, the others at angles of 12 degrees below and above his eyes. Each student saw only one of these three versions. As the authors had predicted, judgments of how powerful the person looked were significantly higher among the students who saw the low-angle version. However, most of the students did not seem conscious of the influence of angle of view. At the conclusion of the study, they were asked directly to comment about camera angles used in the newscast. Out of a total of 78 students who saw either the high- or the low-angle versions, only 13 showed some awareness of this convention in their responses (Mandell, & Shaw, 1973, p. 362). Since similar findings have been reported from a second study of college students' responses to point of view, it would appear that this device is a particularly suitable object for the attention of visual educators.

THE JUXTAPOSITION OF IMAGES

In addition to operating at the level of the individual image, analogical relationships can also be present in the meanings created by bringing two or more images together, either in static displays such as print ads and billboards or in movie sequences. A relatively simple form of analogy is often encountered in film and television editing, whenever the duration of the shots is varied in order to suggest a mood or an emotional tone. Common examples of this practice include the use of fast-paced editing to generate excitement and impart a sense of dynamism to the events in a movie, or slow editing as a means of making things seem more tranquil. These uses of editing rhythm have been tested systematically by Kraft (1986) and Penn (1971), in experiments involving multiple versions of film clips, edited at speeds ranging from relatively high to relatively low. Viewers were asked to rate the activity level of these film clips; as expected, those who saw the versions with faster editing tended to see the clips as more active, while slower versions appeared calmer and more passive. These findings seem readily predictable, and the analogical connections that account for them are probably too obvious to need much explanation. Presumably, viewers' reactions to the pace of the editing are reflections of the way in which people respond to speed and slowness in the events of everyday reality.

A revealing elaboration of this editing principle has been investigated by Welch, Huston-Stein, Wright, and Plehal (1979) in a well-known study of television commercials aimed at children. Aside from the rhythm or pace of editing, this study was also concerned with the nature of editing transitions. In particular, the authors made a distinction between straight cuts, which create an instantaneous transition from one shot to the next, and dissolves or fades, both of which entail a more gradual replacement of one shot by another. The study was based on the assumption that the editing styles of children's commercials would differ according to the gender of the children they were aimed at. An analysis of a sample of Saturday-morning TV ads found support for that view. Commercials aimed at boys were characterized by faster editing and greater use of straight cuts, while girls' commercials had a slower editing pace and were more likely to employ fades or dissolves. The authors interpret these stylistic characteristics as "subtle sex-role cues." In other words, the commercials' editing styles appear to be analogical representations of conventional conceptions of masculinity and femininity: on the one hand speed and abruptness, on the other a more measured and gentle way of being.

An obvious question raised by the Welch study is whether children are actually sensitive to these stylistic evocations of gender. This question was explored in an ingenious follow-up experiment by Huston, Greer, Wright, Welch, and Ross (1984), in which identical commercials were edited in two different ways, corresponding to the two stylistic tendencies observed in the previous study. Children were shown these commercials and asked to guess whether they were intended for girls or for boys. The results showed that the children did indeed seem to have an intuitive grasp of the meaning of these stylistic manipulations. To be sure, this finding does not necessarily mean that the children were able to employ analogical thinking, even implicitly, in making the connection between style and gender. It is possible that they simply recognized the meaning of the editing on the basis of their past experience as viewers of TV commercials. However, if their responses were based even partly on analogical thought processes, this finding is an impressive indicator of young children's capacity for analogical thinking at a relatively high level of abstraction.

VISUAL SIMILE AND METAPHOR

In the editing conventions discussed above, it is the timing of the images, rather than their actual content, that exhibits analogical characteristics. There is, however, a very different form of analogical editing in which the content itself is the key to the analogy. This form of editing has a long history and is often thought of as having originated in the films of Sergei Eisenstein and other directors working in the early years of Soviet cinema. A clear example occurs in a scene from Eisenstein's "Strike" (1925), in which striking workers are massacred by government troops: at the climax of the massacre, Eisenstein edits into the scene a number of shots of animals being butchered in a slaughterhouse. This cross-cutting between the two sets of images can be seen as the

equivalent of a simile. It explicitly juxtaposes two events and implies an analogical connection between them.

Analogical cross-cutting figures prominently in certain films of Eisenstein and his contemporaries in the then USSR. For several years, this device was also popular in Hollywood, where Charlie Chaplin's notorious comparison between factory workers and sheep ("Modern Times," 1936) was one of many direct imitations of Soviet-style editing. Eventually, though, these kinds of juxtapositions became a rarity in fictional movies. As film critic Andre Bazin (1967) argued, the interruption of a movie's story line by the insertion of an extraneous image may have been incompatible with Hollywood cinema's increasing tendency toward unobtrusive narration. Consequently, when such an interruption is encountered in more recent movies—as in Howard Hawks' juxtaposition of kissing lovers and colliding trains in "Man's Favorite Sport?" (1964)—it is almost invariably a deliberate parody.

At the same time when this earlier style of cross-cutting has declined, however, other varieties of visual simile have taken its place. A relatively subtle example of this development occurs in Kon Ichikawa's "The Makioka Sisters," a Japanese film made in 1983. Toward the end of this film there is a scene in which an unmarried woman, who has endured a series of disappointing attempts at third-party matchmaking, finally meets a man she finds attractive. As she faces him for the first time, Ichikawa's camera goes from a shot of her to a shot of wind-ruffled foliage—with red colors prominent—in the window behind her. To a certain extent, this transition is similar to Hawks' pairing of a kiss and a crash. Yet there is also an important difference between them. Hawks' colliding trains appear out of nowhere, in a location that has no spatial relationship to anything else in the movie. In Ichikawa's case, on the other hand, the camera never strays from the space or time of the story's unfolding action. In that sense, Ichikawa's analogy may be considered less obtrusive. It could be argued, therefore, that a viewer has to be somewhat more discerning to spot such an analogy, and that a filmmaker may need to be more resourceful in creating it (Clifton, 1983).

Even less obtrusive visual similes can occur when the two images that are being juxtaposed appear together in a single shot, or when an analogical juxtaposition also serves as a narrative transition. The former possibility is discussed at length by Whittock (1990, pp. 43ff.) in connection with a shot from John Ford's "The Searchers" (1956): the hero of the film (played by John Wayne), riding through a desert landscape, shares the frame with the towering form of an isolated, rugged butte. Citing an earlier analysis by John F. Scott, Whittock observes that, while the analogical connection between rider and background seems compelling once it has been pointed out, the lack of a cut or other deliberate device for highlighting the juxtaposition makes it very easy to miss. Even when there is a cut, though, a visual simile can still be unobtrusive if the cut also serves a narrative purpose, which may monopolize the viewer's attention. The classic example of this latter possibility occurs in Stanley Kubrick's "2001: A Space Odyssey" (1968): a protohuman primate who has just learned how to use a bone as an ax tosses it high into the air, where its spinning is replaced by the movement of a space station in

orbit above the Earth. This is a profound juxtaposition, comprising a wealth of analogical links, but the dramatic narrative leap with which these links coincide can deflect the viewer's attention away from nonnarrative levels of meaning.

Viewers' interpretations of a visual simile embedded in narrative editing have been investigated by Messaris (1981) in a study of college-students' responses to a 10-minute fiction film. In one of the scenes of this film, the protagonist, a fashionably dressed woman, walks into a clothing store; as she passes through the door, there is a cut to the interior of a church, and the same woman appears at the entrance. When the study was being planned, it had seemed to the author highly unlikely that any viewer would miss the analogical implications of the transition between store and church. It emerged, however, that only students with actual experience in filmmaking were particularly sensitive to that aspect of the transition's meaning. The study had been designed as a deliberate comparison among viewers with varying degrees of film-related experience. Students who had made films themselves exhibited a high level of awareness of the store/church analogy. As one of these students put it: "At that point I thought there was a ... over-obvious ... metaphor of fashionable store—church, you know, I thought kind of unsubtle" (pauses in original). And yet, despite this "over-obviousness," among the students without any filmmaking experience the most frequent interpretation of this sequence was purely narrative—that is, the store/church transition was interpreted only as a scene change from one location to another.

These results provide some indication of the potential value of film education for students' capacity to think analogically in contexts where they might not ordinarily be inclined to do so. However, the editing of fiction films is by no means the only source of examples of visual similes. While editing that is based only on analogy, without a narrative component, is now quite rare in mainstream fiction film and television, it appears to be gaining popularity in some forms of advertising and has become a staple of political ads and videos (see Morreale, 1991; Prince, 1990). Juxtaposition based on visual or conceptual analogy between two images is also very common in print advertising. For example, automotive advertisers have featured their products in association with lions (a Toyota ad emphasizing power and dominance over the competition), ice skaters (an Oldsmobile ad emphasizing smooth performance and elegant styling), jet airplanes (a Dodge ad emphasizing speed and power), eagles (a GM ad emphasizing speed and ease of travel), and tigers (the well-known Exxon series). Furthermore, there is another, related category of print advertising that also makes use of visual analogy but presents it in a distinctly different form. A case in point is a National Dairy board ad in which a glass of milk emerges out of a peeled banana. The object is to suggest nutritional equivalence, but this analogy is suggested through a merging or blending of the two foods, rather than a side-by-side pairing. As Kaplan (1990, 1992) has suggested, this kind of blending of the two terms of the analogy may appropriately be thought of as a visual metaphor.

How well do viewers cope with visual similes and metaphors? What role do visual experience and education play in

equipping a viewer for the analogical thinking required in such cases? These questions have been addressed by the present author in a study conducted with Karen Nielsen (see Messaris, 1994, pp. 111–112). This study explored viewers' responses to two instances of analogical editing used for advertising purposes: Ronald Reagan's 1984 reelection campaign film, in which images of Reagan's first-term inauguration are intercut with images of people from various walks of life going to work in the morning (a visual expression of the campaign theme, "Morning in America"); and a TV commercial for fruit preserves in which the picture of the product is juxtaposed with images of nature and life on the farm, presumably as a way of suggesting purity and wholesomeness. These ads were shown to viewers from a variety of backgrounds, including people professionally occupied in TV production.

The central question pursued in the study was whether viewers would see any analogical element in the editing structures of the ads—for example, a comparison between Ronald Reagan and his fellow citizens getting ready to do their respective jobs, or an implied similarity between the qualities of the preserves and those of pristine nature. The results of this study indicated that awareness of such analogical links was higher among TV professionals than among other viewers. For example, while 87% of the former referred to some kind of analogical connection in their interpretation of the Reagan campaign film, the corresponding figure for other college-educated viewers was 59%. In addition to illustrating yet another way in which visual expertise may lead to enhanced analogical thinking, these findings also suggest that teaching students about visual similes and metaphors could contribute to their skills as interpreters of visual advertising.

CONCLUSIONS

The main lessons that emerge from what has been said so far are two: first, that analogical linkages play a major role in a wide variety of visual conventions; second, that the capacity for analogical thought is an important component of intelli-

gence, in science as well as in art. More specifically, the presence of analogical relationships between image and meaning, or between one image and another, has been illustrated in connection with scientific or informational graphics; pictorial composition, the artistic and persuasive uses of point of view, editing rhythm, and visual similes or metaphors in advertising and in narrative cinema. It was noted that, aside from increasing students' fluency in analogical thinking, education about the uses of visual analogy might also improve perspective-taking skills (in the case of point-of-view conventions), as well as students' abilities to think critically about persuasive uses of visual media.

How might educators best respond to these opportunities? The various examples of visual analogy described in this chapter are partly intended as sources on which educators could draw in designing a visual curriculum. Students could be taught to recognize similar devices in artworks and in the mass media and to incorporate this recognition in their critical responses. Perhaps more important, such devices could also serve as models for students' own creative efforts in visual media. Not surprisingly, there is reason to believe that enhancement of visual intelligence is especially likely to occur when students have the opportunity to produce film or other media themselves (see Messaris, 1981; Tidhar, 1984), although there is some evidence that even the experience of viewing can serve as an effective cognitive stimulus in certain circumstances (see Salomon, 1979). Beyond encouraging their students to develop as visual thinkers, educators can also make important contributions to the ongoing task of assessment of aptitudes and achievements in this area. While sophisticated methods have already been developed for the measurement of some forms of visual skills—most notably, spatial intelligence (see Page's chapter in this volume)—there is much less precedent for the assessment of analogical thinking in visual matters. As Gardner (1993) has noted, there is a need for context-sensitive evaluation that measures visual skills as part of students' overall interactions with visual media, rather than through isolated tests. Educators who work directly with students in the classroom are particularly well-placed to respond to this need.

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