Film Studies and the New Science

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Abstract: Film theory has been much involved with psychology, especially with the viewer's perceptual and emotional response to the images on the screen. Psychoanalytic and cognitive film theories, though not exactly kindred spirits, have so far dominated psychological film studies. At the present time, technology offers neuroscience methods to explore the brain that open up the discourse on the mind. This article explains ways in which neuroscience, and its study of the brain, can extend our understanding and theory of film by exploring three areas of our response to cinema. Although the perception of motion is a complicated business, the phenomenon of implied motion suggests the brain's readiness to find movement even when there is none and links together many of the same perceptual mechanisms we use when viewing film and also the world outside the theater. Attention, focus, and binding are essential for us to make sense of the vast amount of stimuli that bombard our eyes. They explain what we see and do not see when viewing film and also the way film technique controls our understanding of the action on the screen. Finally, the argument about what we feel and do not feel when watching the characters on the screen may receive some clarification by neuroscience's investigation of "mirror neurons" in our brain.

Keywords: attention, brain, cognitivism, emotion, film, motion, neuroscience, psychoanalysis

The discussion of film theory often moves us away from experiencing and critiquing individual films. Instead films are used to ground generalizations about the ways we perceive and respond to film. Our responses to specific films are considered for their similarities rather than for their uniqueness. The pleasure of responding to a specific film is very different from our response to the film in the context of a theory. The application of any film theory is always a rewriting of the film and our pleasure is both from the process of rewriting and from our impressions of the rewritten film. In this sense film theory offers its own aesthetic as opposed to the aesthetic of viewing specific films.

Film studies in the Academy have become especially theoretical, in part because of the influence of literature departments, which were already theoretical, and in part because of the significant influence of French theoreticians on American culture. But this theoretical bent is also likely the result of the

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human propensity to see things in the largest context, to want universal laws in art and even in the most every-day of pursuits. We may suppose that all discussions of art are implicitly theoretical, but film studies, like literary studies, made the theories themselves the topic of discourse, creating a metatheory. Although some theories seemed dominant, other theories were discussed and theories frequently overlapped.

An important part of film theory is the relationship between film and the mind. Psychological film theory has been connected to major intellectual trends of the twentieth and twenty-first centuries—psychoanalytic film study was a product of the important standing of psychoanalytic theory in general, especially during the middle part of the twentieth century; and cognitive film study followed naturally from the new field of cognitive psychology, itself part of the growth and popularity of science and technology during the latter part of the century. As the twenty-first century progresses, science and technology are coming together to extend and perhaps change our way of viewing ourselves and also to extend our understanding of film through neuroscience and especially through cognitive neuroscience.

Psychoanalytic Theory and Film

Psychoanalytic theory has had an important impact on our thinking but in recent time this theory has been under attack. Much of this attack is based on concepts that no longer seem justifiable (e.g., the castration complex, penis envy, the etiology of homosexuality, the death wish).[1] Critics of psychoanalysis undercut the good along with the bad; and such discussions also ignore the analytic thinkers and clinicians who followed Freud. It is impressive how much Freud got right and how significantly he influenced the way we think about ourselves and others. Psychoanalysis was for a long period the only seemingly inclusive and significant theory of mind available. But, like most theories, it was not static and fixed.

One can apply Quine and Ullian's notion of a web of belief to the development of psychoanalysis, if one allows the totality of such a web to form a larger theory: "Some of one's beliefs are at length surrendered not through just being crowded out and forgotten, but through being found to conflict with other beliefs, new ones perhaps, whose credentials seem superior" ([1970] 1978: 9). Only ideas held to be true can be called beliefs. Parts of these webs are discarded and, therefore, no longer beliefs and other parts are newly believed and hence part of the theory. It seems to me reasonable and important to recognize the work in ego psychology, object relations, and attachment theory, for example, that followed Freud's own writings.

Psychoanalysis possessed the "two essential characteristics" that Kuhn finds necessary for the schools of science that he refers to as "paradigms"—"Their achievement was sufficiently unprecedented to draw an enduring group of adherents away from the competing modes of scientific activity. Simultaneously, it was sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve" ([1962] 1996: 10).

But psychoanalysis has been attacked for lacking a scientific methodology based upon empirical reality and for not submitting to empirical test those aspects of its theory that are indeed testable.[2] Freud himself had started out as a neurologist, but finding then-current ways of relating mind to body insufficient, went on to develop his system of dynamic psychology without anatomical derivations. Freud, though, continued to look forward to the time when his psychology would be based upon the physical self: "the deficiencies in our description would probably vanish if we were already in position to replace the psychological terms by physiological or chemical ones" ([1920] 1961: 18).[3] Such endeavors have been undertaken in the past but seem more promising in the alliance between psychoanalysis and neuroscience as evidenced in recent publications (Cozolino 2002; Kaplan-Solms and Solms 2000) and the work of the Neuro-Psychchoanalysis Society. Whether this alliance will be enough to reinvigorate and once again popularize the psychoanalytic school remains to be seen.

Psychoanalysis and film began at about the same time and the relationship between the two was noticed almost from the start. Although the images of film are given to us, we experience them as if we are dreaming or fantasizing them in the dark and closed place of the theater. Ingmar Bergman's *Persona* (1966) explicitly deals with the immaterial and psychological nature of the film image (Figure 1). Although Freud himself seemed ambivalent about the possible relationship between the two,[4] in 1926, his Berlin disciples Abrahms

Figure 1. The immaterial and psychological world of Bergman's Persona.

and Sachs entered into a project with film director G. W. Pabst to make the first intentionally psychoanalytic film, *Secrets of a Soul* to honor Freud's seventieth birthday. The theory had to be considerably diluted to make it understandable (and palatable) for the general audience. But we can date this film as the first time that therapy and the relationship between patient and therapist became subjects in a film; the first time that characters were consciously created along Freudian principles; and the first time that the film medium was used to create the psychoanalytic world of dream and the unconscious.

Film remains a fascination for psychoanalysts because of the popularity of the art form but also because it is so analyzable. One approach is to read the film as a psychoanalytic case hour, which means to interpret characters and actions from a psychoanalytic perspective. Another approach is to see characters as creations of filmmakers who impose their own experience and personalities on these fictional beings. In both cases, the reading of the film is similar to the interpretation and creation of a life-story that transpires during the analytic process. A third approach is to use film to document a psychoanalytic theory itself.

Film studies have especially focused on the audience and its response to film. During the 1970s and 1980s the Academy was much influenced by French intellectual writing and film studies, especially by the writing of the French psychoanalyst Jacques Lacan, whose theory of the mirror stage in the child's development was especially attractive to film theorists. Also notable was the revision of Freud's theories by feminist film critics. The writing and discourse became complex and difficult, separate from what transpired in the analytic world but also controversial in its own realm. The primary effort for the reader was to understand the commentary itself and less so to apply it to an individual film or to film in general. Important results of this theorizing were the rise of cognitive psychology in the study of film and some of its chief proponents' strong dismissal of Freudian psychology.[5]

Cognitivism and Film

Cognitivism cannot replace psychoanalytic theory for the simple reason that they are made of different stuff—their concerns are not the same. The argument that one is based on more evidence than the other also raises the question as to the meaning of this evidence. While psychoanalytic theory is concerned with the "what," cognitive psychology is concerned with the "how"; that is, with the processes and not the content. We are fascinated about the ways our minds and bodies work. Like Hans Castorp gazing at his beloved's x-ray in Mann's *Magic Mountain* ([1924] 1946: 348–349), we stare into ourselves, transfixed by our inner selves. We are tantalized by our own image, inside out.

As a school of thought cognitive psychology emerged in the 1950s and 1960s, in part as a reaction to the mindlessness of behaviorism, in part as an attempt to apply a scientific methodology to the study of the mind, but also in part an attempt to see the mind in the context of the new computer technology. Since cognitive psychology is more concerned with process and more modest in its claims than psychoanalytic thinking, it is more difficult to refute. It has often been said that while psychoanalysis is a theory in search of a science, cognitive psychology is a science in search of a theory. But it seems to me there are a sufficient number of theories to go around for both categories (what Bordwell and Carrol refer to as "middle-level theories" [1996: xiii–xvii]) if we do not look for a single, all-inclusive one.

Cognitivism as a school of study has spread its wings and is no longer easy to describe, though we can always see its basic thrust—in this respect it is not much different from psychoanalysis. Cognitivism itself is a catchall term that incorporates cognitive science, cognitive psychology, cognitive theory, cognitive philosophy, and cognitive film theory. On occasion we even attempt to bring cognitivism and psychoanalytic thinking together.[6] But, for the most part, cognitivism claims to be free of the subjectivism and irrationalism of psychoanalysis and is based on both empirical evidence and reason.

Except for a few interesting essays by Julian Hochberg, cognitive psychologists tended to stay away from film, but film scholars were ready to accept this new school of thought and experimentation because of the opaqueness of psychoanalytic film theory and especially because this field dealt directly with perception, memory, and emotion—and what else was film about? Cognitive film theory offers virtually a second by second account of the ways in which we respond to the cinema. An important turning point in the conflict between psychoanalysis and cognitivism in psychological film theory came with the appearance of David Bordwell's *Narration in the Fiction Film* (1985) and Noël Carrol's *Mystifying Movies: Fads and Fallacies in Contemporary Film Theory* (1988), both of which started an erosion in the support of psychoanalytic film theory. By the time these two writers edited their volume *Post-Theory: Reconstructing Film Studies* in 1996, film theory had significantly turned away from the psychoanalytic models of the past and the door had opened wide for the cognitive study of film.

The word "cognition" means the process of knowing (i.e., perceiving, thinking, feeling, remembering, learning, etc.), but viewing a film is not identical to the perception we perform in the world outside the theater—the images are an illusion and the viewing experience is far more controlled. In the process of understanding the way viewers perceive a film we also separate ourselves from these viewers because of our privileged theoretical information. We are theorizing about imaginary viewers seeing a film so at some point we become cut off from both the actual viewer and film. The work of cognitive and analytic film scholars must also be speculative and theoretical because they are adapting the findings or claims of others to the film experience, already perceived through the guise of theory. It is really an issue of some theories seeming better than others because they are based on more solid evidence, which seems to be the case at this point in time for cognitive film theory.

We find satisfaction in cognitive film theory from watching ourselves in the process of watching. It is the belief of seeing our cognitive facilities working in a logical and methodical way that makes us think we are able to understand our interior life during the experience of watching a film. The concerns of cognitive film theory also mesh nicely with those of the new cognitive neuroscience that relates such mental acts to the actual processes of the brain. But these concerns and processes offer little self-awareness, little awareness of the self responding in a personal way to the film, creating a dialogue between the self and other. Here we can only speculate about our consciousness emerging from our physical brain.

The New Science

As the telescope opened up our knowledge and theories about the universe and the microscope about the world too small to be seen by the naked eye, so have recent advancements in understanding the brain-mind relationship been fostered by such technological advancements as electroencephalography (EEG), magnetoencephalography (MEG), positron emission tomography (PET), and functional magnetic resonance imaging (fMRI). Cognitive neuroscience's findings are exciting because they locate a source in our brain for much that we see and do and much that we have always taken for granted. But cognitive neuroscience, because it proceeds along such modest steps, is susceptible to much theorizing, especially in the discussion of higher functions. The goal is to close the gap between the brain and mind.

Viewing a film is an intensely emotional perceptual experience. Isolated from the distractions of normal every-day life, the viewing experience also encompasses the psychological paraphernalia we use in coping with the world outside the theater. For these reasons, film spectatorship is an ideal context for examining the workings of the mind in general. Although cognitive neuroscientists are just beginning to directly investigate film spectatorship, their preliminary findings are of great interest because of what they tell us about some basic responses of our brain to film, but also because of the potential of these findings to undercut some theoretical beliefs about the film experience as well as to support others and establish new ones.

I am going to suggest only a few areas of film spectatorship that seem to me especially compatible to cognitive neuroscience. But a word of caution is necessary at this juncture: We do not proceed into the maze of scientific experimentation to prove anything definitively; instead everything is theory. W. V. Quine says that all the experimentation in the world cannot settle an "ontological issue" because "such issues are connected with surface irritation in such multifarious ways, through such a maze of intervening theory" (1960: 276). And then there is the endless relationship between language and theory, each shifting to accommodate the changing nature of the other—"Our boat stays afloat because at each alteration we keep the bulk of it in tact as a going concern. Our words continue to make passable sense because of continuity of change of theory: We warp usage gradually enough to avoid rupture" (ibid., 4). If we cannot come to any conclusions about reality, if reality must always remain an illusion, than those unreal images on the screen (and sound filling the auditorium) are even more pertinent.

Motion in Images

Francis Crick and Christof Koch suggest in their article "A Framework for Consciousness," which appeared in *Nature Neuroscience,* that "conscious awareness [for vision] is a series of static snapshots with motion 'painted on them'" (2003: 122). Because perceived motion is static in each image, "it can only change between snapshots, which suggests that there is little or no explicit representation for such a change." The idea was picked up by Oliver Sacks in the *New York Review of Books* the following January when he discussed a number of patients who, during migraine attacks, "may lose the sense of visual continuity and motion and see instead a flickering series of 'stills'" (2004: 43).

Sacks had first discussed these cases in *Migraine,* where he referred to this phenomenon as "cinematographic vision" because his patients compared this vision to "films run too slow" ([1970] 1992: 74–75). Sacks also refers to a case of "motion blindness" reported by Josef Zihl and colleagues in Munich in 1983, in which a woman who had suffered a stroke that had damaged a portion of the visual cortex could see movement only as a series of freeze frames (2004: 43).

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Koch returned to the subject in a recent essay in *Scientific American Mind,* "The Movie in Your Head" (2005: 58), where he suggests that the rapidity with which these snapshots appear might explain why time seems to pass slowly or rapidly. When snapshots increase in duration, fewer are perceived in a second and thus events seem shorter and more rapid. When snapshots are shorter and hence increase in number, time appears to pass more slowly. (Also see Koch 2004.)

Among our low level processes, vision is divided in the primary visual cortex into parallel pathways, the dorsal stream, which is concerned with "where" (depth, direction, location, and motion) and the ventral stream, which is concerned with "what" (form, surface, color) (Ungerleider and Mishkin 1982). The second stream developed in primates later in the history of evolution. The perception of motion is a complicated business beginning with the stimulation of cells in the retina followed by signals making their way through the dorsal stream. Cells in the middle temporal (MT) area are highly responsive to parts of an object moving in a certain direction. Each cell has some awareness of what the other cells are doing and the entire motion process system. "Motion perception reduces to the problem of establishing continuity . . . establishing what parts of each frame correspond to which parts of each preceding frame" (Albright 1993: 180).

Next to the MT region is one referred to as the medial superior temple (MST), part of which is thought to be responsible for optical flow—the motion we see in the world when, for example, we move forward or turn our heads. "Heading" is a term for indicating the direction of our movement.[7] "For example, when an individual moves forward with eyes and head directed straight ahead, optic flow expands outward from a point straight ahead in the visual field, a pattern that is frequently used in movies to show space ship flight" (Kandel et al. 1991: 553).[8] A gradual turn of the head creates an optical flow created in film by a pan of the camera.

Clearly the motion system has a certain autonomy in the brain. It does not respond to static objects and can still operate even if signals are cut of from the primary visual cortex. Zeki and ffytche (1998) report of blind individuals who are able to "see" motion though not the specific moving object because fast motion also activates part of the brain distinct from the primary visual cortex.

Because of the relative autonomy of this motion system, the brain has a predilection to pick up motion even when there is none, and is ready to override certain circuits. Examine below the much-discussed painting, *Enigma* by Isia Leviant, (1984). Although the work is more effective in its original color, you should be able to notice in the black and white version the sense of movement in the circles, at some point even reversed (Figure 2). Margaret Livingston explains this phenomenon as resulting from the "Juxtaposition of luminance-contrast borders [borders between the brightest and darkest areas] with areas of equiluminance [where there is little contrast between two areas]"[9] (2002: 163; also see Kumar and Glaser 2007; and Leviant 1996).

Much has been written about implied motion and the subject has provoked a whole battery of neuroscientific experiments in recent years to figure out its reason and cause. The example of *Enigma* is an immediate and dramatic example of how activity in a limited area of the brain can create a visual response in excess of the stimuli given (Zeki et al. 1993: 221). But implied motion is a factor in more natural and much simpler pictures containing "representational momentum"—for example a person running, an arrow in the air—in which the object is "extrapolated forward" in the mind (Senior et al. 1999).

The brain's capacity to use the same neurons to perceive implied motion as actual motion explains why we are able to see motion in art when none exists. The mind is programmed and ready to project out from itself the illusion of motion upon art that is static, and the historical development of pictorial art is from stasis to kinesis. Why this predilection to see motion where there is none? Kregelberg and colleagues suggest that it is a matter that derives from survival: "The unity of perception requires that sooner or later information on form be combined with information on motion. . . . This may reflect a strategy . . . to survive in an environment in which combinations of object motion and self motion; occlusion and transparency complicate the tasks our visual system has to solve" (2003: 676).

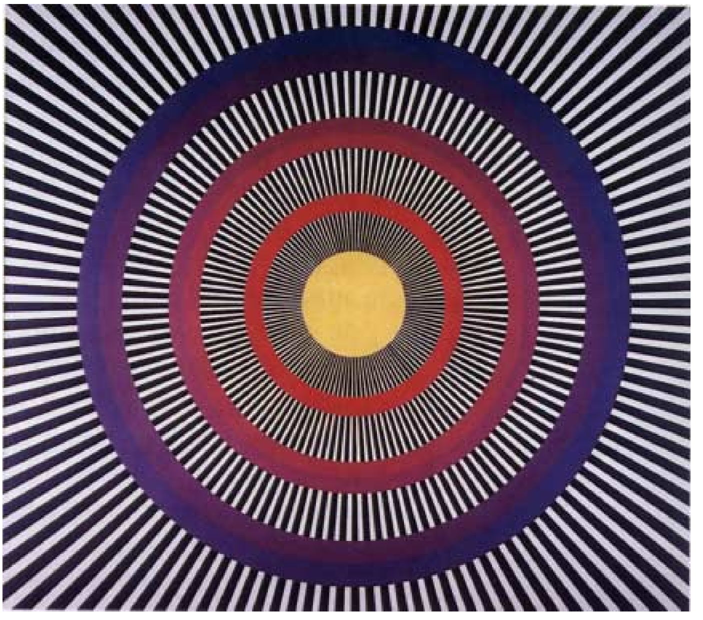

Figure 2. Isia Leviant's Enigma *creates for us a sense of movement amid its static image.*

Motion has its own story in the history of art, a history of representational moments where the artist seeks to overcome the limitations of the medium, and, by conveying a caught instant in time, suggest the past and future moments. I mention three examples of this dynamic quality, separated in time and place, to document my point. In classical Greek art the fifth-century B.C. relief of the Elgin marbles demonstrates how animation can be suggested even in the hard world of stone. Paolo Uccello's fifteenth-century *Battle of San Romano* imposes action on a world of bizarre perspective and form. Marcel Duchamp's *Nude Descending a Staircase No. 2* (1912) is a cubist and futurist interpretation of motion influenced by photographic studies and early movies. Rudolf Arnheim has observed that the visual pattern in painting is a field of force—the psychological equivalent of physiological forces active in the brain's center of vision ([1954] 1971: 5). I suggest that this field of force is a result of the brain's impulse to impose motion on the static world before it.

The attempt to create an illusion of motion distinct from the actual motion that surrounds us was evident in the host of nineteenth-century gadgets created for this purpose—for example, the Phenakistiscope, Stroboscope, Zoetrope, Praxinoscope—all dependent on a series of rotating images. Eadweard Muybridge's celebrated series of photographs of subjects in motion (created with multiple cameras and lenses) were intended to dissect motion but printed together form a remarkable map of, for example, the human body moving, with each picture capturing a specific instant but very much connected in our mind to the preceding and following images. Once Étienne-Jules Marey in France was able to perform the same feat with a single camera in a method he called chronophotography (the word "chrono" is from the

Figure 3. F.W. Murnau's Sunrise *demonstrates how motion could become part of visual art.*

Greek "chronos" meaning time), we have almost arrived at the period of Edison and the Lumiére brothers and the early development of the motion picture.

Certainly people were taken by the spectacle of the event, but it was primarily motion that fascinated audiences at the start of the motion picture. The projected images of people and objects in motion on the screen, in a frame, created a sight never seen before—it was as if painting had become alive. Chases, automobiles, slapstick filled the screens. F.W. Murnau's *Sunrise* (1927), with its expressionistic perspectives and moving camera, filled the screen with motion and demonstrated how motion could become part of visual art (Figure 3).

Moving in a world of motion we scarcely notice the everyday action that surrounds us. But sitting in a restaurant, the person across from us looks over our shoulder to stare at a television screen, not knowing what is going on but caught by the sheer motion of the image. It is the persistence of motion in a world of partial motion—persistence emphasized by the circumscription of the area—that grabs our attention. Our brain, which is so sensitive and ready to see motion, is naturally drawn to this intensity of movement.

I started this section by presenting the argument that we see the everyday world as "a movie in the head," made up by a series of static snapshots upon which the brain imposes motion. It has been argued that the perceptional processes taking place when watching a film are the same we use when perceiving the world outside the theater. The claim is reasonable, but we are seeing a different world in the theater and we are seeing it in a different way. In our everyday world our seeing is often automatic and unconscious. In the theater we have no choice, and no desire, but to look, to see, to gaze. In the dark, sitting in a position that allows us to look only in front of us, at a specifically framed image, larger than life and continuously changing, we experience an intensification of our visual process, of our visual system. At times, we may not be conscious of all that we are seeing but we are always conscious that we are seeing. Starting with our earliest art of animals leaping with implied motion on the walls in the caves of Chauvet and Lescaux to the latest adventure film with its symphony of running bodies and careening cars in the closed space of the movie house, neuroscience explains the world of art from the natural functions of our brain.

Attention, Focus, Binding

Visual art demands our attention. Looking at Johannes Vermeer's *The Art of Painting* (1666–1668), we first get a "gist" of the entire scene (Koch 2004:165). Here is a likely scenario that follows. In response to this gist, our eyes dart about and are immediately attracted to the painter because of his dark clothes and position close to the foreground. The viewer is next drawn to the object of his gaze, the young woman in the background who wears a wreath and holds a trumpet and a book.[10] Although she is one of the smaller objects in the room and slightly out of focus, her central position between the artist and well-defined curtain on the left draws us into the depth of the scene where she is positioned. Our eyes then follow a kind of elliptical movement, examining the large map behind her, noticing the golden chandelier in front of the map, looking at the sharply defined curtain to the left and perhaps the chair below (Figure 4).

Figure 4. Johannes Vermeer's The Art of Painting *creates for us a pattern of attention.*

Our examination of painting is similar to the way we assess a situation in the actual world—our eyes dart about in saccades, that is from fixed point to fixed point, taking in the general situation. Our attention is drawn to some salient or important object and we focus in on it, examining it in some detail. We find difficulty in staying unfocused in general or focused on a static object for a period of time. The process of attention originated in the brain as a means of survival and still performs that function—but now it does much more. Rita Carter makes the point that attention "is necessary for thinking, and possibly for consciousness" ([1998] 1999: 186). Visual art manipulates and enhances this process, and especially enriches it by involving our perception in a world unlike our own. Objects are perceived amid the interplay of earlier schemas stored in the mind and the novelty of these objects' present appearance.

Carter points out three elements necessary for attention—arousal, when the brain "picks up a new stimulus"; orientation, when the eyes disengage from the previously perceived object and turn to the new stimulus; and focus, when the eyes lock in on and highlight the object and send information to the frontal lobes that maintain focus (ibid.). Objects of our attention play a role in an initial image of the scene and are seen in relation to other objects that draw our gaze. When we focus on an object centrally with our foveal vision and with the help of our surrounding parafoveal vision, we also obtain information from our peripheral vision with varying degrees of awareness (Solso 2003: 92).

When watching a film, we must attend to the image while it is in motion. Watanabe and Miyauchi suggest "that attention to motion enhances the stages that are directly involved in the processing of the type of motion to which attention is directed" (1998: 104). Our eyes seek out some focal point, something or some things to attend to in the midst of the image's change. At that instant countless neurons in our visual cortex are firing in response to all the elements of the scene before us, forming competing groups (Koch 2004: 177). The group of neurons responding to the most salient object before us will likely turn on our attention. In a short time our attention (and the firing of these neurons) weakens—unless there is some change or motion in the object itself—and our attention quickly moves to another salient element. The action within the scene keeps us more alert and speeds up the entire process of attention as the image changes. Attention takes on meaning only in the context of our greater awareness of the scene. Editing and changes in perspective widen our implicit vision. But all the while we are watching the drama on the screen, a drama is also taking place inside our brain that literally guides us in following the action before us.

The simplest way to control our attention is by cutting from shot to shot while focused on an object in middle shots and close-ups. In longer shots especially, filmmaking includes a panoply of techniques for focus that control the viewer's attention. Bazin praised deep focus, when the entire scene is in focus, because it allowed the viewer freedom to choose an object of attention ([1950–1955] 1971: 33). But such scenes, as those he praises in *Citizen Kane* (1941) are as carefully composed as Vermeer's painting to guide our attention in a certain way (Figure 5). Opposed to deep focus is shallow focus that keeps only a small area of the scene defined; selective focus that defines more

Figure 5. The deep-focus shots in Citizen Kane *also compose a pattern of attention.*

specifically a subject or area; rack focus when the camera defines one object after another with the previous one going out of focus; and follow focus when the camera follows a moving object, keeping it continuously defined. Part of the pleasure of viewing a film is having our attention guided in an immediate and controlled manner, seeming to have the camera do the looking for us—following the objects of definition one after the other, we impose on them some kind of relationship and, ultimately, some kind of narrative.

The examination by Thomas, the lead character in Michelangelo Antonioni's *Blowup* (1966), of a series of his photographs and enlargements is a short textbook on the spectator's attention and focus when viewing the photographic image. Thomas notices something in blow-up after blow-up, focusing in on a small object in the print, defining it better and better. At first he focuses in on a woman and a man. Following her glance at some blur in the brush, he closes in on the object and makes out a man with a gun. In a final blow-up, he discovers the body of the man he had previously seen embracing the woman. An object of his attention leads to the next object of his attention. The more he looks, the more he sees. The more he sees, the more we see. With Thomas, we put together objects of attention and discover a crime.

Thomas seeks to define blurs in the photograph, to give them form and meaning through the process of binding. According to Merlin Donald, "Binding is the theoretical basis of object perception or more accurately, the neural means of attaining perceptual unity" ([2001] 2002: 179). Our eyes are bombarded with a flood of light rays and somehow we select out what it is that we wish to (or have to) see. Different aspects of the object—color, shape, size, texture, and so on—are processed in different parts of the brain and must somehow be bound together for us to perceive the object. At the same time binding allows us to distinguish one object from another. Binding seems to be a later evolutionary development of attention in mammals. We become aware of our visual systems' continuous efforts to bind objects on the screen when an object comes into or goes out of focus or one object morphs into another (Rothstein et al. 2005).

But attention is also selective. Sometimes our attention is so focused on certain elements in the scene that we fail to see important inconsistencies even after repeated viewings. In James Whale's *Bride of Frankenstein* (1935), Henry Frankenstein cringes against the wall at the side of the image as the monster is about to blow up the laboratory, yet seconds before he had escaped with Elizabeth (and seconds later he will appear embracing her as the film ends). The filmmakers had changed their minds about killing off Henry, but found it too expensive to re-shoot the big explosion—and, besides, no one would notice. Also unnoticed by audiences is a Volkswagen "bug" moving backward in the rear of the dream sequence at the end of *Carrie* (1976). De Palma had shot Amy Irving walking backward and then reversed her motion to give her an unearthly walk—the auto's forward motion was thus also reversed in the scene.

These are occurrences of "inattentional blindness"; but perhaps more significant is the phenomenon called "change blindness," when some significant aspect of the object of our attention changes without our awareness.[11] In one experiment two men carrying a door passed between a psychologist and a person he was addressing. During this interruption, the psychologist changed places with one of the workers, a change unnoticed by the person being questioned on half these occasions (Levin and Simons 1998: 644–649). In an article published in *Science*, a team of Swedish scientists reported an experiment in which participants were asked to choose the more attractive woman in two photographs. The participants were then shown the wrong photo and asked to explain their choice. A significant number did not realize the change and proceeded to answer the question (Johannsson et al. 2005).

Change blindness has been attributed to a variety of visual disruptions or distractions but also to inferences that we make on the basis of earlier images. Another explanation might be a phenomenon called "masking," when, in a flow of images, one overrides another (Koch 2004: 257). But, then, if we stared at a picture long enough, a change could gradually appear without our noticing (Simons et al. 2000). Levin and Simons point out that "reviewing research on scene perception showing that the similarity between film and natural perception includes a common tendency to perceive events as continuous in the face of large view-to-view inconsistencies" (2000: 357). In film such unplanned changes from shot to shot are multitudinous (the reader might check the list of mismatches for *Star Wars: Episode III—the Revenge of the Sith* [2005] on the IMDb Web site).[12]

With all the wonders of our visual process, seeing is a very directed and motivated action. When our brain is intent on doing something, it can easily override what actually exists before our eyes. The world bombards our sight with a myriad of phenomena but our brain can only process so much and must choose what it wishes us to see and not to see. Sometimes the brain can be fooled because of its stubbornness, but this stubbornness always has logic in the neuroscience of the brain.

With all the wonders of our visual process, seeing is a very directed and motivated action. When our brain is intent on doing something, it can easily override what actually exists before our eyes.

Mirror Neurons and Empathy

In an article published in *Science* in 2004, Uri Hasson and his colleagues describe an experiment in which individuals were shown thirty minutes of the 1966 Clint Eastwood film, *The Good, the Bad and the Ugly* while their brains were studied by functional magnetic resonance imaging (fMRI). They discovered "a surprising tendency of individual brains to 'tick collectively' during natural vision" (1634)—some 30 percent of the entire cortical surface of the subjects reacted in the same manner. Striking was the similar activity of the brain when individuals attended objects even in complex scenes, and also the similar activation of the "face-related and building-related region." (1636). Although the areas of similarity are striking, Hasson and his colleagues also "found a pattern of areas which consistently failed to show intersubjective coherence" (1638). So we begin this last section of my discussion with the assumption that our brains function much the same when we view a movie, but with enough latitude to allow us some unique feelings and reactions.

An interesting area of study in neuroscience has been the location of the sense of self in the brain, the "I" who lives inside of us, who is aware of our subjective states, who does all our thinking for us, and who is the source of the image we possess of who and what we are. The brain area most associated with this sense of self is the medial prefrontal cortex (Gusnard 2001). But this sense of self seems to disappear as the related area of the brain shuts down when we are fully engaged in activity outside ourselves: "Quite paradoxically, during truly intense sensory perceptual states—such as watching an absorbing movie, or being involved in a highly demanding sensory task—the strong subjective feeling is of 'losing the self,' i.e., of disengaging from self-related reflective processes" (Goldberg et al. 2006: 330).

The question of who or what or where we are when watching a film has been much debated. How much of our selves do we lose? We can assume that a significant part of our reaction to a film will come unconsciously from our own predispositions, character formation, experiences, culture, and from the schema we carry around in our heads. But what exactly is going on inside our heads when watching a film? We have established that our brains are functioning with considerable similarities but this only explains the process and not the content. Where is the "me" if the "me" no longer seems to be there—or, at least, fully there?

In May 2000, on the Edge Foundation Web site, the noted neuroscientist V. S. Ramachandran published an essay within which he made the following claim:

> *The discovery of mirror neurons in the frontal lobes of monkeys, and their potential relevance to human brain evolution . . . is the single most important "unreported" (or at least, unpublicized) story of the decade. I predict that mirror neurons will do for psychology what DNA did for biology: they will provide a unifying framework and help explain a host of mental abilities that have hitherto remained mysterious and inaccessible to experiments. (1)*

Ramachandran refers to a development in neuroscience that began with Italian scientists discovering in 1996 that a similar group of neurons in the premotor cortex of a monkey's brain were set off when the animal both carried out a particular action and observed the same action performed by another agent (see, for example, Gallese et al. 1996; Rizzolatti 1996). Similar experiments have been performed demonstrating that humans also have such "mirror neurons" when performing and then viewing the same action on video (Cochin et al. 1998) and also when experiencing and then seeing touch on video (Keysers et al. 2004). Experiments have demonstrated that similar neurons are fired when we feel pleasure or disgust and when we see these feelings on the faces of others (Jabbi 2007). Vittorio Gallese (one of the original investigators in this field) puts these neurons into a likely context: "The coordinated activity of sensorimotor and affective neural systems results in the simplification and automatization of the behavioral responses that living organisms are supposed to produce in order to survive" (2001: 46). We do more than read minds, then. We instinctively pick up the emotions of others in our daily lives, socially and defensively.

At this point, one cannot say that Ramachandran's prediction has been fulfilled but the subject of mirror neurons has certainly increased in popularity. The number of papers on the subject is vast; the entries on the web grow day by day; and references in magazines and newspapers suggest that the concept may go mainstream.[13] Mirror neurons have been extremely valuable in studies of childhood development, learning, language, and imitation.[14] Although the possibilities of the subject in aesthetics seem great, mirror neurons have so far taken only a few steps in that direction. The subject of mirror neurons and film, where the spectator constantly watches the actions of others and reads the emotions expressed by their faces seems especially promising.

The term often applied to this phenomenon is "empathy." This term has been much used in humanistic studies, psychology, and neuroscience—often interchangeably with identity, sympathy, and association. In neuroscience the distinction between reacting to someone else and being the other person undergoing an experience is sometimes obscure. It seems to me that there are three major components to the term: (1) I understand what the other person is feeling; (2) I feel for the other person's feelings; and (3) I feel the other person's feelings. Point three is where the problems arise.

A good amount of work in neuroscience concerns itself with "face perception," which is much related to the "fusiform gyrus face area" in the brain. (This area is part of an entire region of the brain at the end of the ventral stream that responds to features of specific objects and sends signals to other parts of the brain for representation.) When this area of the brain is damaged, the victim suffers from prosopagnosia, an inability to recognize familiar faces (Kandel et al. 1991: 499). A related issue, also significantly connected to this part of the brain and its mirror neurons, is our ability to read faces, to perceive the emotions and, perhaps, intentions of another person. This ability to understand such facial signals from others—this mind reading—was a crucial step in our evolutionary development and is the basis of our social life today.

Daniel Goleman sums up two processes that go on during this perception of face:

> *While we attune to the other person, the brain undergoes two varieties of empathy: a fast-low road via connections between the sensory cortices, thalamus, and amygdala, and on to our response; and a slower high-road flow that runs from the thalamus up to the neocortex and then down to the amygdala and so on to our more thoughtful response. Emotional contagion runs through that first pathway, allowing our automatic neural mimicking of the feelings of the other person. But that second pathway, which loops up to that thinking brain, offers a more considered empathy, one that holds the possibility of shutting down our attunement if we choose to. (2006: 325)*

Perhaps we can relate to this statement something we often say to others: "I understand you. I know what you are feeling." How can one know what another is feeling without undergoing that same feeling? We may have been in a similar situation at one time, undergone similar feelings, but how do we remember a feeling? If we can begin to understand how the brain works, perhaps we can understand empathy with less ambiguity and ambivalence.

Goleman (2006) is saying that another person's feelings send off signals to neurons in our brain similar to those neurons responsible for the feelings in the other person. In certain situations we might sense some danger or threat and pick up the other persons feelings of fear or anger. Laughter might also be contagious, and it is difficult to stifle a yawn when we see the person in front of us yawning. But in most cases, we are likely to modulate or inhibit the feelings in ourselves that we are watching expressed by others, either through "the thinking brain" or through chemical inhibitors at some points in the circuit. After we pick up the signals we identify them from our emotional memory and instincts for survival but also realize that they are not our own and we cut them off to varying degrees. I may see someone in pain and flinch or feel ill, but I am not feeling the same pain even though my mirror neurons for pain are firing off in the same way. To paraphrase a statement by Freud—I describe the strange state of mind in which one feels and does not feel a thing at the same time.[15]

Charles Darwin's *The Expression of the Emotions in Man and Animals* ([1872] 1998) demonstrates the universality of facial expressions for specific emotions. It may well be that we are all programmed to feel and communicate feelings in similar ways. We also know that there must be variation in the way we feel and react to someone else's feelings. Beginning with the child mimicking the mother's facial expressions we are learners who learn through experience, both imitating and responding to the faces of others.

Previous familiarity with a face must also play a role in determining our reactions. Robert Zajonc discusses the "mere exposure effect," the fact that we feel positive effects when seeing an object we have seen before even without recognition (1980: 161). In a recent paper on perceiving the faces of celebrities, Rothstein and colleagues (2004) defined a three step process: taking in the various physical properties of the face; identifying the face; and bringing to bear one's long-term familiarity with the face. Quiroga and his colleagues (2005) discovered that a subset of neurons in the medial temporal lobe (MTL; an area in the middle portion of the brain, including the hippocampus, that is located at the bottom of the cortex and is crucial for memory) responds to the face of a specific star (e.g., Jennifer Aniston or Halle Berry) and not to another performer or not when the actress is viewed in conjunction with another performer. Quiroga and colleagues (2005) surmise that this firing of the neurons is a result of long-term memory and not immediate perception. Our responses to a face, then, will be influenced by how well we know that face. What is the difference in our reaction to an emotion expressed by John Wayne and some unknown performer? Wayne's face may carry a lot of significance for us, but does the display of emotion override the degree of familiarization or does the familiarization add to the emotion? (See Figure 6.)

Figure 6. How much does our failiarity with a face impact on our emotional response?

This phenomenon likely explains the failure of Robert Montgomery's 1947 film, *Lady in the Lake* in which he plays private detective Philip Marlowe and presents most of the action through the character's eyes. The audience misses the physical presence of a person with whom it can empathize, a face to which it can emotionally respond. But, admittedly, some faces are hard to love. The first time audiences saw the face of Frankenstein's monster (1931), played by Boris Karloff, was in three progressive shots that took them right into the creature's disturbing face. Yet after this experience, some kind of empathy does develop in the scenes where the monster seems bewildered and childlike.

There are faces and there are faces. Norma Desmond's line in *Sunset Blvd*. (1950) is pertinent here: "We didn't need dialogue. We had faces!" The close-up has its own special history in cinema. But, as Carl Plantinga points out in his essay on the human face in cinema, "Empathetic response also depends on *affective congruence* between narrative context, character engagement, various uses of film style and technique, and the psychological impressions and responses they generate" (1999: 253). Watching a movie is a very complicated business but at the heart of the experience is always a human face.

Most of the experiments on mirror neurons must, by necessity, require the subject to perceive the action or emotion in a picture, which is likely to produce some major distinctions from seeing an action or emotion on someone's face in actuality. Crucial differences also exist between looking at an image in a test situation and sitting in a movie theater watching the image on a large screen. And there are also the distinctions between my own emotional sensitivity and history and those of a person next to me.

But I share with the person next to me, and with the person next to him or her, some kind of emotional (and social) bond when we are watching the film. Our laughter is contagious. We share the sad parts, seeming to empathize together with the character on the screen. I started this section citing an experiment by Uri Hasson and his colleagues (2004), in which they demonstrate the considerable congruence of our minds when watching a film. I then cited an experiment by Goldberg and his colleagues (2006), in which they indicate how that part of the brain responsible for our sense of self shuts down when we are experiencing something like a film. I don't think we ever loose the sense of "me" when watching a film but our sense of self is certainly diminished and the barrier around us removed, allowing us at times an astonishing intimacy with the world and faces on the screen. Neuroscience in its study of the brain gives us insight into our most intimate moments in the theater.

Neuroscience and Film

Eclecticism has its benefit when discussing art, especially the motion picture with its wide variety of elements and complex human responses. Neuroscience in many of its interests follows naturally from cognitive science as it begins to examine our basic responses in the movie house. And psychoanalysis is also achieving some validation in its concepts of the unconscious, dream, memory, and childhood development—all subjects important to our understanding of art. I have only touched upon three areas in the relation of brain to film. As time goes on, we will discover more but I do not think we will ever reduce the movie-going experience, nor the brain, to a series of formulae. We will know much about the functions of our brain and how it generates our perceptions, emotions, and thoughts; but each brain is finally unique, filled with the memories and experiences of an individual past, shaped by different cultures and backgrounds, and, hence, wired differently in certain aspects. But even here we will learn a certain methodology and reason in how and why we become unique at the very time that we share the experience of art.

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Notes

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[1] I do not deny the metaphoric relevance of some of these terms or that they may be applicable in specific instances. But it does seem to me that they no longer seem relevant as general rules of human behavior.

[2] Among the works that seek to close the breach see Shevrin et al. 1996.

[3] For a discussion of Freud's early career in neurology and an overview of his comments on the subject throughout his psychoanalytic career, see Kaplan-Solms and Solms (2000: 3–25).

[4] "My chief objection is still that I do not believe that satisfactory plastic representation of our abstractions is at all possible" (Freud and Abraham 1965: 384).

[5] David Bordwell, in his discussion of cognitive-film theory, makes the following critique: "For psychoanalytic theory in general, the paradigm cases are the neurotic symptom (the core of the core), the bizarre dream, the bungled action, the slip of the tongue. These are the central phenomena, which Freud sought to explain. Out of the explanations he built an account of human mentation that went much farther, to include all normally unexceptional behavior and much of artistic activity" (1989: 12). In spite of the overall excellence of the essay, this description is neither accurate nor conducive to debate. Noël Carroll has a similar attitude toward psychoanalytic theory but makes a cogent point when he argues that psychoanalytic film theorists do not have the benefit of the therapeutic practice upon which psychoanalytic thinkers in general base their theories (Bordwell and Carroll, 1996: 66). Clinical case studies do not have the rigid methodology that one would expect of scientific experimentation, but they offer some empirical evidence for the various categories of psychoanalytic theory.

[6] See Allen's *Projecting Illusion: Film Spectatorship and the Impression of Reality* (1995).

[7] Much work in this field was done by the experimental psychologist James J. Gibson when seeking to create ways to test pilots for the airforce during World War II (see especially Gibson 1950).

[8] Also see Konigsberg (2000: 73–74).

[9] Livingston points out that equiluminent colors by themselves cause a sense of motion in an object because, though properly seen by the "What system," such an object is "Invisible (or poorly seen) by the Where system" (2002: 66).

[10] The figure supposedly represents Clio, the goddess of history.

[11] For a number of examples of both inattentional and change blindness see the "Demos and Stimuli" page of The Visual and Cognition Lab at the University of Illinois (http://viscog.beckman.uiuc.edu/djs_lab/demos.html).

[12] http://www.imdb.com/.

[13] An article in the *New York Times* of January 7, 2007, titled "Why Our Hero Leapt Onto the Tracks and We Might Not," tells us of a daring rescue that might be attributed to "mirror neurons." The concept has likely received some attention because of Daniel Goleman's recent book, *Social Intelligence* (2006). As I revise this entry (March 22, 2007), I see in the *New York Times* (A19) a report of some research appearing yesterday on the Web site of the journal *Nature*. Scientists compared the willingness of a small group of people with damage to the ventromedial prefrontal cortex to people without this injury in taking direct, hands-on action to sacrifice one person's life for the safety of a larger group. All six people with the injury were twice as likely to claim a willingness to sacrifice personally the life of the individual. As the study of the brain continues we can explain better the behavior of people.

Lawyers are already using brain imaging in defending clients. The issue of free will and personal responsibility becomes more and more complicated.

[14] *Mirror Neurons and the Evolution of Brain and Language* (Stamenov and Gallese 2002) covers some of this territory.

[15] Freud's original statement is "I have never managed to give a better description than this of the strange state of mind in which one knows and does not know a thing at the same time" (Breuer and Freud [1895] 1955:117)

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