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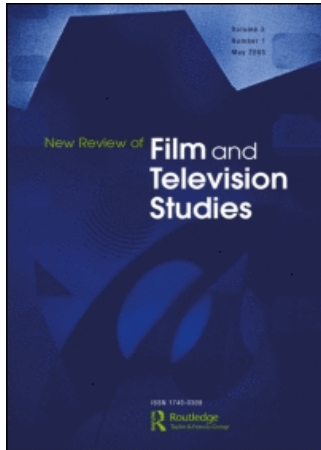
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Nick Redfern

CONSTRUCTING MOVEMENT IN THE CINEMA

In this paper I adopt a Radical Constructivist approach to understanding the viewer's experience of motion in the cinema. Rejecting both realist and illusionist arguments, I argue that in watching a film the viewer constructs movement by generating the individual identity of an element of their perceptual field over time.

Introduction

The development of the cinema and of film studies has been overdetermined by two opposing traditions: the 'Manichaeic division between the films of Lumière (documentary realism) and the films of Méliès (fiction, fantasy, stylisation)' (Gunning 1990, p. 96). Our understanding of cinematic motion is similarly torn between those who claim that the movement experienced by the viewer in watching a film is real (Currie 1995, 1996) and those who argue that this experience is an illusion (e.g. Baudry [1974] 1999; Bordwell 1985; Sparshott 1985; Anderson & Anderson 1993, 1996). In this paper I reject both illusionist and realist arguments as being unable to account for the viewer's experience of movement in the cinema, and I argue that the viewer constructs movement in the cinema. This idea is not new—in 1916 Hugo Münsterberg argued that the experience of movement in the cinema was the product of the viewer's interpolation of movement when a stimuli is perceived at different locations at different times, so that movement is 'not seen from without, but is superadded, by the action of the mind' (Langdale 2002, p. 77). Unfortunately Münsterberg died the following year, and so this intriguing insight was not developed into a coherent description of movement in the cinema. It is my goal here to advance such a description through looking at the Radical Constructivist account of the concepts of change and motion that have been proposed by Ernst von Glasersfeld (1984, 1991, 1995). Glasersfeld's analysis of these concepts is of interest to film scholars as he uses the cinema as a means of illustrating how these concepts function, and does so from a philosophical position that is distinct from the traditions of realism and illusion that have hitherto shaped our understanding of the

cinema. In the light of these concepts the description of movement in the cinema I propose is one in which the viewer constructs the movement they experience by generating the individual identity of an element of their perceptual field over time.

Theories of movement in the cinema

To date, theories of movement in the cinema have taken three forms:

- the strong illusionist argument takes movement to be a part of the grand illusion of the cinema in which we have only the impression of moving pictures as part of our wider 'impression of reality' in watching a film;
- the weak illusionist argument claims that there is no movement on the screen; rather, there is only a succession of still images, and the movement we perceive in the cinema is an illusion because it is a function of the way in which we perceive a film;
- the realist argument has been proposed by Gregory Currie (1995, 1996), in which he claims that the viewer literally sees movement on the cinema screen.

In this section I outline these theories and I go on to reject all these accounts of cinematic movement as being unable to account for the viewer's experience of movement in the cinema.

The strong illusionist argument

The strong argument that the viewer's experience of the cinema is an illusion is typically associated with contemporary film theory. Semiotic and psychoanalytic theorists claim that our experience of the cinema is fundamentally illusory, that we are subject to a grand illusion that is comparable to a dreamlike or hallucinatory state (Baudry [1976] 1999; Metz 1982). Illusion in this sense is the false consciousness of ideology that the cinema reproduces via its visual codes creating an 'impression of reality' in the viewer: the differences between individual frames of a film are 'suppressed', so that the discontinuous individual images 'disappear' and movement and continuity can 'appear' (Baudry [1974] 1999, p. 349).

The projection operation (projector and screen) restores continuity of movement and the temporal dimension to the sequence of static images. The relation between individual frames and the projection would resemble the relation between points and a curve in geometry. But it is precisely this relation and the restoration of continuity to discontinuous elements which poses a problem. The meaning effect produced does not depend only on the content of the images but also on the material procedures by which an illusion of continuity, dependent on persistence of vision, is restored to discontinuous elements. These separate frames have between them differences that are

indispensable for the creation of an illusion of continuity, of a discontinuous passage (movement, time). But only on one condition can these differences create this illusion: they must be effaced as differences.

(Baudry [1974] 1999, p. 348)

Baudry appears to understand film to be a device for the storage of time and movement, so that continuous movement before the camera is recorded and stored as a series of discontinuous images on film, which when projected will *restore* the original movement to its continuous state. While the impact of light on the photosensitive emulsion of film may be fixed in place the syntactic information that is recorded is only the intensity of the light and its associated position in the frame (Read 1998, p. 1). This argument also has no basis in human psychology or physiology: Baudry refers to 'persistence of vision' as the mechanism by which the viewer comes to experience movement, but as has been demonstrated by Anderson and Anderson (1978, 1980, 1993), and Nichols and Lederman (1985), the phenomenon of persistence of vision is a myth that in no way accounts for the viewer's experience of movement.

First, 'persistence of vision', the term, the concept, the myth, must be given a place in the history of film scholarship, but can no longer be given currency in film theory. The time has surely come when only the creationists among us will cling to the myth of persistence of vision as an actual explanation of how movies come to be. Second, and more important, the concept of the passive viewer implied by the myth, the one upon whose sluggish retina (or brain) the images pile up, must be replaced by an enlightened understanding of how viewers actually interface with motion pictures.

(Anderson & Anderson 1993)

Contemporary film theory, however, has not risen to this challenge to find new explanations for the phenomenon of cinematic motion and has, in the face of cognitive film theories, apparently abandoned the subject completely and retreated into its interpretative shell.

Not all versions of the strong illusionist argument have been constructed within the framework of contemporary film theory, but unfortunately there is no explicit theory of movement in the cinema. Ed Tan argues that films are *emotion machines* that simulate the natural environment in order to elicit emotional responses in the viewer, and while these responses are emotionally authentic they are the products of the 'illusion of diegetic effect', 'the illusion of the controlled witness' and 'the illusion of the observational attitude' that create 'the illusion of being present in the fictional world' (Tan 1996, p. 52). However, these illusions are considered voluntary, whereas the illusion of movement is considered involuntary so that some perceptual/cognitive processes lie behind the control of

the viewer while others do not. Alternatively, Richard Allen (1995) has argued against the illusionist account of the cinema put forward by contemporary film theorists, and has advanced the argument that our impression of reality in the cinema is a 'projective illusion', in which the viewer knows that he or she is watching a film but is able to experience the world presented before them as being fully realised. If it is to be understood as part of a projective illusion on the part of the viewer, this would imply that the viewer is able to suspend his or her knowledge that a film is a cellulose strip of still images and actively 'project' the illusion of motion—a position not too distant from that of the weak illusionists discussed below. However, like other versions of the strong illusionist argument no explicit description of movement in the cinema is provided.

The weak illusionist argument

The weak illusionist argument states that there is no movement on the screen; rather, there is only a succession of still images, and the motion we perceive in the cinema is an illusion because it is a function of the way in which we perceive a film. This theory has been developed by those who are primarily concerned with the aesthetics of film such as Haig Katchadourian, who states that a film 'is necessarily a sequence of visual images that create the illusion of movement' (1985, p. 134); while Frank Sparshott (1985, p. 284) writes that a film is 'a series of motionless images projected onto a screen so fast as to create in the mind of anyone watching the screen an impression of continuous motion'. Cognitive film theorists such as Joseph Anderson, Barbara Fisher Anderson and David Bordwell have also developed this idea. This version of illusionism is taken as the standard description of movement in the cinema:

Films produce the illusion of continuous movement by passing a series of discrete images in quick succession in front of a light source enabling the images to be projected on a screen. Each image is held briefly in front of the light and then rapidly replaced with the next one. If the procedure is rapid and smooth enough, and the images similar enough to each other, discontinuous images are then perceived as continuous and an illusion of movement is created.

(Cherchi-Usai 1996, p. 6)

The viewer perceives continuous motion because the cinema exploits what Bordwell describes as 'two physiological deficiencies' in our visual system:

First, the retina is unable to follow rapidly changing light intensities. At critical 'fusion' frequency, more than fifty flashes per second will create the impression of steady light. Second, the phenomenon known as apparent

motion occurs when the eye sees a string of displays as a single moving one. This effect depends on the fact that the eye will infer movement from an intermittent input if the jumps are not too large.

(Bordwell 1985, p. 32)

We ‘cannot fail’ to perceive motion because that is the nature of our perceptual/cognitive apparatus, and the cinema is ‘a medium of illusion’ that ‘counts on our making “wrong” inferences’ (Bordwell 1985, p. 32, original emphasis). For example, Anderson and Anderson (1993, 1996) claim that the motion we perceive is the result of transformations made by our visual system when confronted with multi-element or closely spaced displays. They argue that:

Since we know that the individual pictures of a motion picture are not really moving, and that our perception of motion is therefore an illusion, and since we *now* know that the effect has nothing to do with persistence of vision or phi movement, we suggest that henceforth the phenomenon of motion in the motion picture be called by the name used in the literature of perception—*short-range apparent motion*.

(Anderson & Anderson 1993, original emphasis)

Short-range apparent motion refers to the motion the visual system infers when it is confronted with rapid, closely spaced stimuli (such as a film of near-identical images projected at, say, 24 frames per second), and is believed to involve a mechanism identical to our perception of ‘real’ motion.

For instance, a series of neon arrows lighted up in succession are perceived as being a single arrow moving through space. The illusion of continuous motion is called apparent motion to distinguish it from ‘real’ motion, which is perceived when an object moves continuously across a viewer’s visual field. When Sir Laurence Olivier appears to be fencing in a film, he is in apparent motion, whereas a person walking across the theatre in front of the screen is in real motion.

(Ramachandran & Anstis 1986, p. 102)

As the brain cannot distinguish between this type of motion and ‘real’ motion we mistake the former for the latter: ‘The visual system ... seemingly cannot distinguish between short-range apparent motion and real motion. To the visual system the motion in a motion picture *is* real motion’ (Anderson & Anderson 1993, original emphasis).

The weak illusion argument rests on the fact that the viewer has two different types of knowledge about a film—that ‘the individual pictures of a motion picture are not really moving’ even when he or she sees them ‘move’. However, this argument is based on an inappropriate comparison between two different types of

experience of film. The roots of this problem lie in the different uses of the noun 'film' with reference to the cinema: on the one hand, a film is a flexible base coated in light-sensitive emulsion; whilst, on the other, a film is a representation of events recorded on such a medium. Though the viewer may know of the material nature of a film, when speaking of 'watching a film' he or she refers to the projected representation of events, as opposed to watching the film move through a projector or in a motionless heap on a table. The knowledge of film in its material form is radically different from that of film-as-representation, and as the object of reference in each aspect of the viewer's experience is different (the strip of still images and the projected images on a screen) there is no basis for a comparison. Richard L. Gregory writes that though a subject may know he or she is being deceived and yet continues to be deceived—as the viewer who knows that the images on a strip of film are not moving but continues to experience movement in the cinema—shows that perception and conception are 'different, and largely separate' (1986, p. 137). Furthermore, in this situation the viewer is not comparing his or her experience of moving pictures with the physical reality of a series of still images by some external procedure that confirms the nonveridical nature of his or her perception of movement. As such, this does not constitute 'some external procedure'. Rather, the viewer is comparing two radically different experiences of film, and 'it is not clear that we should deny motion to cinematic images just because we know that their underlying bases do not move' (Kania 2002, p. 249).

The weak illusion argument distinguishes between short-range apparent motion and 'real' motion to explain the illusory nature of movement in the cinema, but Anderson and Anderson claim that the human visual system is unable to distinguish between these two types of motion, so that to the viewer these classes of motion are *functionally equivalent*. However, this raises the question that if the brain cannot distinguish between short-range apparent motion and real motion, so that to 'the visual system the motion in a motion picture *is* real motion', then on what basis is it claimed that such motion is an illusion? Surely, we would either have to consider such motion 'real', or all so-called 'real' motion would have to be considered as being an illusion. Furthermore, allowing for the fact that researchers on perceptual psychology are human, how did they come to the conclusion that short-range apparent motion is different from 'real' motion when the viewer in the cinema, who I also assume to be human, cannot tell the difference? Surely, if the human visual system cannot distinguish between short-range apparent motion and 'real' motion, it is methodologically impossible to establish such a distinction using a human visual processing system. These problems are the result of researchers making an a priori distinction between short-range apparent motion and 'real' motion that is assumed to hold true even though this difference is not perceived by the viewer. It is important to note that this is an ontological argument about whether or not images in the cinema move

or do not move, and tells us nothing about the viewer's experience in watching a film for which such a distinction is irrelevant.

Anderson and Anderson claim that:

A visual illusion occurs when a normal visual system following its own internal rules processes the patterns of light before the eyes [...], and yet the resulting perception is nonveridical—that is, by some external procedure it can be demonstrated that perception is at considerable variance with physical reality and is therefore not a reliable basis for action.

(1996, p. 354)

They fear the charge of epistemological anarchism, and are resolute in their 'opposition to cultural relativism in all of its forms' (Anderson & Anderson 1996, p. 350), but, Anderson and Anderson do not demonstrate how 'by some external procedure' our experiences can be considered veridical (in the psychological sense of 'coinciding with reality') or otherwise. In the absence of a description of such a procedure by which the non-veridical nature of the viewer's perception may be established, it is not possible to determine whether or not the movement he or she experiences is an illusion.

The realist argument

Rejecting all illusionist arguments, Currie (1995, 1996) defends a thesis of movement in the cinema he calls *perceptual realism*. Though his defence of this thesis is a metaphysical one, Currie claims that it would be an error to attack his version of realism on metaphysical grounds, as he postulates no observer-independent world:

[T]he concept of illusion is in fact entirely irrelevant to understanding the nature and function of film. It is realism, not illusionism, that needs to play a central role in film theory. But the realism we need is not just anti-illusionistic, it is anti-absolutist as well; the realist need not believe that the world is fully describable without taking into account subjective points of view.

(Currie 1996, p. 341)

His claim to realism is that our experience of watching a film 'approximates the normal experience of the real world' because 'film is, or can be, realistic in its recreation of the experience of the real world' and he argues that 'we literally see movement on the screen, just as we literally see colour. Colours are real, and so is cinematic motion. There is therefore no "illusion" of movement, and it is literally true that films are moving pictures' (Currie 1996, pp. 325–326). Currie

argues that movement is not only real but also dependent on the responses of the viewer to the images projected onto the screen.

The better criterion for the identity of cinematic images across time is their relation to the mental states of the viewer. This image is the same as that because both are identified by normal viewers in normal conditions as being images of the same individual. Here again, as with colour, the concept we appeal to is response-dependent. Identity between images is itself a response-dependent concept, because questions about how to re-identify images across time are measured by appeal to facts about the psychological responses of the viewer to those images.

(Currie 1996, p. 340)

As it is dependent upon the responses of the viewer, Currie argues that movement in the cinema should be understood not as a primary quality, but as a secondary quality.

Like Anderson and Anderson, Currie clings to realism in order to avoid the charges of relativism that have been laid at the door of those who adopt an anti-realist stance, but his argument is contradictory. He mounts a metaphysical defence of realism but claims that it would be unfair to challenge his thesis on metaphysical grounds because he makes no claims about a world that exists independently of the viewer. He then claims that that 'we literally see movement on the screen' and that 'there really is movement within a single shot taken from a fixed perspective' (1996, p. 335), and in doing so postulates precisely the viewer-independent world he denies. At the same time he claims that in the case of the cinema 'we shall have to acknowledge a kind of motion which takes its place among the secondary qualities' (1996, p. 342), and is necessarily understood to be dependent on the responses of the viewer.

Considering the possible relationship between cinematic motion and the perceptual realism of the viewer raises a further problem. Andrew Kania makes the point that in ordinary motion 'an object occupies contiguous spatial locations at contiguous moments in time' but that this is not the case in the cinema because each projected image is separated from the next by a short period of darkness (2000, p. 250). From this we should conclude that the viewer's experience of movement in the cinema is different from his or her experience of ordinary movement, and Currie seems to acknowledge this, referring to cinematic motion as 'a kind of motion' to be distinguished from motion that is traditionally understood as a 'paradigmatically primary quality' (1996, p. 342). However, this goes against his fundamental claim to realism that the viewer's experience of watching a film is similar to his or her ordinary experience.

Currie's argument ultimately fails because it is not clear how the viewer comes to experience movement in the cinema—indeed, he is so concerned with

the ontological problem of whether or not the images we see on a screen are really moving he provides no description of what perceptual or cognitive processes are involved in the viewer's response. His assertion that the response-dependent nature of cinematic movement is 'perfectly compatible with the reality of the images concerned' (1996, p. 340) can be neither denied nor proven, as he describes no means by which this 'perfect compatibility' can be established. Whatever movement may be 'literally on the screen' is not demonstrated to be accessible to the viewer, and therefore is not demonstrated to play any part in the viewer's perception of movement.

Constructing movement in the cinema

In rejecting illusionist and realist theories of movement in the cinema I argue that the viewer *constructs* movement when watching a film by generating the individual identity of an element of his or her perceptual field over time.

Constructivism is the epistemological argument that knowledge is actively built up by a cognising system (such as a viewer in a cinema), and is based on the insight that such a system is *organisationally closed* and has no access to an external reality. Such closure is a necessary quality of a cognitive system, and is described by Johannes Müller's *law of specific nerve energies*, which states that no matter how a sensory system is stimulated, the resulting sensation will always be of the type appropriate to that system (Müller 1826). For example, the stimulation of the optic nerve will result in visual sensation regardless of whether that stimulation is by flashing light, by electric shock or by pressure on the eye (Norrzell *et al.* 1999); and this sensation is dependent upon the part of the brain in which the sensory pathways terminate and not the stimulus. Thus we 'see with the brain, not the eyes' (Bach-y-Rita *et al.* 2003, p. 285) as the images that pass through the pupil and are focused on the retina go no further: 'The sole source of output from the retina to the rest of the brain is the action potentials arising from the million or so ganglion cells' (Bear *et al.* 2007, p. 300). The brain has no independent reference as to the cause of electro-chemical signals that are transmitted along the optic nerve because the 'response of a nerve cell does not encode the physical nature of the agents that caused its response. Encoded is only "how much" at this point on my body, but not "what"' (Foerster [1973] 2003, p. 214). The cognitive system, then, interacts necessarily with its own states because the nervous system is a closed network of interacting neurons, in which any change in the state of relative activity between some components of the network leads to a change in the state of relative activity between other components of the network (Mpodozis *et al.* 1995).

The conceptual framework of Radical Constructivism is built upon the organisational closure of the cognising system, and has been developed by Ernst

von Glasersfeld (1984, 1991, 1995). As the cognitive system is organisationally closed, it is impossible to know anything independently of that system because there is no external point of reference for such a system. As a consequence, constructions are consistent and coherent, but necessarily circular. Experience is a form of *self-reference*. However, Radical Constructivism does not permit an anarchistic approach to knowledge: constructions are historical assemblies and form networks of hierarchical dependencies, in which subsequent constructions are built upon earlier ones. As such they impose constraints on one another, restricting the degrees of freedom with which the cognitive system can build up new concepts. The construction network of the mind is understood to be necessarily non-arbitrary, and the function of cognition is understood to be not the discovery of an ontological reality; rather, it is adaptive and serves the cognitive system's organisation of the experiential world (Piaget 1954; Glasersfeld 1988). The key to evaluating the knowledge constructed by a cognitive system is not to seek to compare it to a mind-independent reality that cannot be known, but to assess its *cognitive viability*—the extent to which it affords such a system with ways and means of thinking and acting in order to achieve its goals.

It is within this framework that Glasersfeld conducts his analysis of the concepts of change and individual identity, and these are suggestive for film studies for two reasons: first, he uses the cinema to illustrate these concepts and by focusing on these arguments we can apply them to the cinema itself; and second, he does so from a philosophical position that is different from both those of the illusionists and realists. It is important to emphasise that Radical Constructivism is distinct from the arguments I have outlined above and does *not* seek to negotiate an intermediate position between them. Rather it is a theory that requires philosophers to make a radical break from the generally accepted view that our knowledge of the world must lie somewhere between materialism and idealism (La Moigne 1995); or, to put it another way, to make a break from the view that our understanding of the cinema must lie somewhere between Lumière and Méliès. Radical Constructivism is a theory of *knowing* rather than a theory of *being*, and in adopting such an approach it is possible to make a significant step in our understanding of the cinema: it is not the point of a theory of motion perception in the cinema to determine whether or not images are moving, but to develop a model of how the viewer *knows* cinematic movement.

In order to explain the concept of change from a Radical Constructivist perspective Glasersfeld draws on the cinema as an example, and in seeking to explain movement in the cinema this argument can be inverted. He gives the following example:

If you watch an arrow flying through the air, you see it move and change place from the moment it leaves the bow to the moment it hits the target. If, however, you consider it at any one moment during its flight, it does not

move. Zeno knew nothing of movies, but we have in the form of cinema film is a perfect illustration of what he was suggesting. A film showing the flying arrow would be made up of a series of still frames. Each frame would show a stationary arrow at a slightly different place. If we saw only a single frame, we might guess that the arrow was moving, but this would be an inference made by analogy to other experiences we have had of arrows. The single frame itself contains no movement.... Yet when we see the film projected, we see the movement. Thus the question arises: how can this experience be generated?

(1995, p. 80)

To clarify Glasersfeld's argument, each still image of the arrow would, in fact, be blurred due to the technological restrictions of the camera: rather than a perfect still image, each frame of the film is an *integrated* image of the motion of the arrow for the period of exposure the shutter is open. This effect is called *motion blur* and is a strong visual cue to motion. In motion pictures, motion blur allows the viewer to experience smooth and natural motion without the negative effects of strobing and staccato movement between frames, even though the viewer is rarely conscious of the effect (Burr & Morgan 1997). While the viewer may not notice its presence, in the absence of motion blur movement appears unnatural, and it is for this reason that animators and/or filmmakers working with computer generated imagery (where there is no motion during the time the film is exposed) *add* motion blur to counteract the sharpness of the image (Brostow & Essa 2001).

The perception of change in the example of the arrow involves the analysis of two moments of experience and the identification of a difference between those moments. As this analysis involves the knowing subject in reflecting on his or her own experiences it is *self-referential*, and knowledge of the arrow's movement 'must be constructed by the observer in his or her field of experience' (Glasersfeld 1995, p. 80). A simple difference in position between two frames is not sufficient to speak of movement in the cinema—that movement must be associated with an element in the viewer's experience (i.e. the arrow) that is considered to be the same element at two different moments. This implies that a theory of cinematic motion must be attentional (Büchel *et al.* 1998), and involves generating the *individual identity* of a perceptual object over time. The concept of individual identity is 'the posited identity of an experiential object that, during one or more attentional frames, is not present in the subject's perceptual field' (Glasersfeld 1995, p. 85).

The concept of individual identity is key in understanding cinematic motion because the projected images of a film are not continuously present in the perceptual field of the viewer. Currie claims that movement of an image from one place on the cinema screen to another is an image 'sustained by the contiguous impact of light on the surface of the screen' (Currie 1996, p. 340), but this is not

the case: in order to maintain a sufficient frame rate to avoid flicker, the shutter in a film projector interrupts the image two or three times for every frame. As a consequence each frame is separated by a micro-moment of darkness, and though we experience these brief periods of darkness we are not consciously aware of them if they are short enough: 'It does not matter if, during an hour-long film presentation, there was no light being projected on the screen for over thirty-minutes of the total, just as long as each individual period of darkness did not exceed a certain limit' (Enticknap 2005, p. 142). A cinematic image, then, is *not* continuously projected onto the screen, and Andrew Kania writes that, as a metaphysician, he would be

rather reluctant to admit items into [his] ontology which went in and out of existence, even if, like Currie's images, they normally did so fast I would not notice it. But even if one did allow them into one's ontology, one would surely not immediately allow that if they disappeared in one place and reappeared in another they were simply moving from one place to the other.
(Kania 2000, p. 250)

However, such occlusion is a part of our everyday experience (Shimojo & Nakayama 1990), and neurophysiological studies indicate that our perceptual and cognitive systems have evolved to solve the problem posed by objects moving behind occluding surfaces (Michotte 1950; Piaget 1954; Assad & Maunsell 1995; Yantis 1995; Culham *et al.* 1998). For example, Olsen *et al.* (2003) suggest that when we see a moving object pass behind an occluding surface neurons in the intraparietal sulcus (IPS) and the middle temporal (MT) regions of the brain maintain a representation of motion when the target object briefly disappears. The IPS and MT areas of the brain appear to process motion that is inferred or expected but not seen, being activated during seen motion and continuing to be activated when a target undergoes occlusion. Olsen *et al.* propose that the function of these areas of the brain is to 'maintain a representation of a target both when visible and when not visible' (2003, p. 101). In fact, recent research indicates that occlusion itself is a significant cue in the perception of motion (Engel *et al.* 2006).

In a cinema, the viewer faces a similar problem: when he or she watches a film the viewer experiences an image (IM1) followed by a micro-moment of darkness followed by a second image (IM2). The viewer's construction of motion in the cinema is thus dependent on his or her ability to maintain the permanence of an object that moves in and out of his or her perceptual field, and this involves comparing our experiences of an object with subsequent experiences of that same object. This relationship is represented in figure 1. The identity of cinematic images is not to be understood in relation to the mental states of the viewer as no such relation can be established; instead it is necessary to understand how the



FIGURE 1 The generation of individual identity in the cinema (after Glasersfeld).

viewer generates the identity of cinematic images by putting their mental states in relation to one another over time, and 'any such continuity in the existence of an individual object is, under all circumstances, the result of operations carried out by the cognising subject and can never be explained as a given fact of objective reality' (Glasersfeld 1984). For example, when we watch a film of a horse running across a field we construct the movement of the horse by establishing its individual identity from one frame to the next as the succession of still images moving through a film projector is interrupted by the projector's shutter; and though we experience micro-moments of darkness between successive frames, the movement of the horse we construct is continuous because our representation of the horse's movement is maintained even though the image of the horse is momentarily not visible to us. Therefore, as Glasersfeld states:

[D]epending on the conditions of perception, we see [film] as a sequence of individually different images or as one continuously moving image. Irrespective of any 'real' horse that may or may not have trotted somewhere at some time and been filmed while doing so, when the film is presented to us, we ourselves must construct the motion by constituting a continuous change of one horse from the succession of images. The fact that we do that unconsciously cannot alter the fact that we have to do it in order to perceive the motion.

(Glasersfeld 1984)

Movement in the cinema cannot be understood as anything other than the product of the viewer's perceptual and cognitive systems. On this point Currie, the weak illusionists and myself are in agreement. However, if this is the case such movement cannot be considered to be 'real' as Currie describes it, as this would place it beyond the experience of the viewer. Though the reality of moving pictures may be denied (or is, at least, unproven), it does not follow that

cinematic movement must be understood as an illusion. It is not the case that we mistake our impression of reality for the 'real world'; rather, it is through the active processes of constructing and organising our experiences that we constitute the very reality in which we operate. In establishing the relationship between our experiences of an object over time, we construct the movement we experience in the cinema.

Conclusion

Currie writes that there 'ought to be room for a position which suggests that colours and other secondary properties [i.e. movement] belong to the realm of appearances, but which denies that the experience of colour [movement] is illusory' (1996, p. 340). The Radical Constructivist analysis of change and motion, and its application in describing the viewer's experience of the cinema offers one such position. What a Radical Constructivist approach to the problem of movement in the cinema shares with Currie is the argument that our experience of watching a film is similar to our non-cinematic perceptual experiences, and it shares with the weak illusionists the understanding that the cinematic spectator is actively engaged in watching a film; but a Radical Constructivist analysis requires us to reject both the illusionist and realist theories, and demands that we go beyond the traditional categories in which the cinema has been understood and radically rethink the nature of movement in the cinema.

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