The Art of Puppetry in the Age of Media Production

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Steve Tillis

The figure I have just created has the beautiful sheen of polished wood. As it walks along, its face catching the light just so, I feel a little proud—and more than a little amazed. For I have neither touched nor carved into the figure, and I control it with neither strings nor rods. This figure—which, if I were to continue my labors, I could place amidst similar figures in a production of, say, *Hamlet*—has never had any tangible existence. It is nothing more, and has never been anything more, than a series of computer commands that have resulted in a moving image on a screen.[1]

The figure—my Hamlet, let us continue to say, who makes bold enough to tell the traveling Players "to hold [...] the mirror up to nature"—is not itself of nature: it is of a new breed of figures that perform primarily in the media of film, video, and cybernetics (i.e., computers). More specifically, it is like certain of the dinosaurs in Stephen Spielberg's *The Lost World* (1997) and all of the characters in John Lassiter's *Toy Story* (1995), being a figure of computer graphics (Duncan 1997:81 and passim; Pixar/Walt Disney Pictures 1995).

Computer graphics figures (also known as CGI, "computer graphics images") are not the only members of this new breed. Somewhat older in their technological origination are the kind of figures in Tim Burton's *The Nightmare Before Christmas* (1993) and in the central portion of Henry Selick's *James and the Giant Peach* (1996): stop-action (also known as stop-motion) figures. For the moment, let me speak of the characters created through computer graphics and stop-action as "media figures": figures whose performance is made possible through technological mediation. Indeed, there is yet another kind of figure that in many respects may be said to belong to this new breed, and though it is not strictly a media figure, it is most often to be found on film or video. One can see these figures in a great many contemporary films, including Barry Sonnenfeld's *Men in Black* (1997), but also among the resident nonliving characters at Disneyland: these are animatronic figures (Pourroy 1997; Anderson 1997).

It might seem that the various figures I have mentioned do anything but "hold a mirror up to nature"—being, in the main, figures of fantasy; but this is as much a function of economics as artistry: Why bother with the expense of a "naturalistic" media image when an actor can perform such roles easily enough?

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Media figures are, thus, left most often to enact non-naturalistic roles, at which they happen to excel. In this regard, the figures are rather similar to puppets as we have known them, which have frequently held up the mirror less to nature than to the untrammeled imagination of the puppet-artist.

It has proved difficult, however—at least from the perspective of puppetry—to make much theoretical sense of media figures: How are they like or unlike puppets as we have known them, and on what basis might some or all of them be considered puppets? Media figures share with puppetry the crucial trait of presenting characters through a site of signification other than actual living beings.[2] While this trait is certainly necessary for their inclusion into the world of puppetry, is it sufficient? What follows is a preliminary attempt to answer these questions. As computer graphics figures seem to offer the greatest challenge to puppet theory, they will be the primary subject of my remarks. What I have to say, however, will have a bearing on stop-action and animatronic figures as well, and so I will mention them again toward the end of this essay.

It seems almost obligatory to refer, preferably in one's title, to Walter Benjamin's landmark essay of 1933, "The Work of Art in the Age of Mechanical Reproduction."[3] Such a reference, however, is useful here primarily to show how Benjamin's critique of mechanical reproduction (most especially as it occurs in film) is inapplicable to media figures, and so to suggest that these figures present a new problem for theory.

"Even the most perfect reproduction of a work of art," Benjamin writes, "is lacking in one element: its presence in time and space, its unique existence at the place where it happens to be" ([1933] 1969:220). For the actor working on film—and, by extension, for the film puppet as well—this "presence" is spoken of as an "aura"; Benjamin makes much of the actor's "feeling of strangeness [...] before the camera," occasioned by the fact that, in front of the camera, one must forgo one's "aura"—that is, one's actual presence (229–30). Again, by extension, one might speak of the puppet's aura as well, with the puppet conceived of as a "work of art" that, as with all works of art, "has its basis in ritual, the location of its original use" (224). Puppets cannot, of course, feel strange in front of a camera, but their lack of feeling does not obviate the estrangement that takes place when the actuality of their physical presence is reduced to a mere two-dimensional look-alike. Media figures, however—most obviously those created through computer graphics—cannot generally be said to lose their presence in time and space when presented by their particular medium, for their presence is actually created by the medium. They are not media reproductions, that is, but original productions made possible through media. "That which withers away in the age of mechanical reproduction," writes Benjamin, "is the aura of the work of art" (221); but in the age of media production, it is the aura of the work of art—a work without any "unique existence" in time and place—that is created. Media figures are something new, not only chronologically but also conceptually, and just as Benjamin's analysis is incapable of accounting for them, neither are they accountable by concepts of puppetry that have their basis in the puppets we have heretofore known. For better or for worse, the age of media production is a new age that must be accounted for on its own terms.

There have been at least two serious attempts to provide something of an accounting from the perspective of puppetry. In 1991, the Board of the North American Center for the Union Internationale de la Marionnette (UNIMA-USA) voted to create, along with its Citations of Excellence for "live" puppet performance, a citations category for "puppetry in video," later expanded to encompass all "recorded media" (Levenson 1992:1). Pursuant to that end, Mark Levenson, then Chair of the UNIMA-USA Citations Committee, devised criteria for entries in the new category, and confronted, along with other matters of eligibility, the vital question of what, in the context of "recorded media," constitutes a puppet (2). The "test" that Levenson proposes runs as follows:

> Technology must not be used to create the puppetry, only to record it. That means that the performance must be at all times under the control of a live, human puppeteer, performing in what computer folks call "real time." This performance is recorded and the recording may be manipulated (i.e., edited) prior to presentation to the audience. (2)

Levenson goes on to note that his proposed test would "exclude traditional and stop-motion animation," but would "include animatronic figures if their animation were created by an operator in real time" (2); he does not address computer graphics figures, which had already come into being at the time of his writing, but it is obvious that he would exclude them also from the realm of puppetry. I should add that Levenson's criterion of "real time" (hereafter to be written as "real-time") apparently refers to a synchronicity between the puppeteer's control and the puppet's resultant movement. (Curiously, Levenson is not concerned with real-time vocal performance, probably because it is so rare in film and video.) An alternate meaning of real-time would refer to a synchronicity not only of control and movement, but of audience reception as well. When computer graphics figures are employed for such "real-time operation and reception" performance, as I will discuss below, the generally accepted term for them is "performance animation" (see, for example, Luskin 1997).

One of the most striking aspects of Levenson's "test" is how it echoes Benjamin's argument. The dictum that "technology must not be used to create the puppetry, only to record it" seems but another way of saying that eligibility for the Citation should be limited specifically to puppetry that is "mechanically reproduced" on video or film. No doubt Citations honoring excellence in recorded puppetry are a valuable function of UNIMA-USA, and no doubt Levenson has proposed a useful test of inclusiveness. But the inability of Benjamin's argument to account for media images is reflected in Levenson's near-categorical exclusion of them from consideration. Levenson recognizes that media figures are in some way fundamentally different from puppets as we have known them; his preference (which arises at least in part from the institutional context for which he proposes his test) is simply to put them aside, as a rule, rather than to consider them as—at least potentially—the puppetry of tomorrow.

The second serious attempt to grapple with media figures and puppetry was undertaken in 1994 by Stephen Kaplin, in an essay entitled "Puppetry into the Next Millennium." Kaplin's approach to media figures is diametrically opposed to Levenson's, as evidenced by his focus on "computer-based, cybernetic technology" (1994:37). While Levenson draws a strict distinction between puppetry and media figures (not even bothering explicitly to mention computer graphics), Kaplin concerns himself exclusively with such figures as puppets.

Kaplin writes of four "aspects of the new technology that can be applied to puppet performance in the near future" (37); alternately, he calls these aspects "emerging sub-genres" (39). The first is "docu-puppetry," which makes use of "sampling, cropping, and re-editing" of media images and involves the "depictation in puppet performance of factual and authoritative material, illustrating historical, social or cultural phenomena" (37). The second emerging subgenre is "virtual puppetry," which involves "performing objects that exist only within the computer, generated out of digitized bitmaps, given tightly controlled behavior parameters and linked by manual controls to the outside, human world" (38); this is, in essence, a description of computer graphics figures. The third of Kaplin's subgenres is "hyper-puppetry," which is "a collective extension, a corporate entity [of a computer-generated puppet], created out of the merged energies of [a theoretically "unlimited" number of] users/ participants" (38). Finally, Kaplin writes of "cyber-puppetry," by which he means networked-computer puppetry with an online, "interactive" dimension that "allows for the artist to conceive of performances as collaborative creation[s] with the audience" (38).

It is exciting to read Kaplin's vision of emerging forms of artistic creation, but worth noting that all four of his subgenres are fundamentally related. Docu-puppetry, hyper-puppetry, and cyber-puppetry, that is, are but variations of the virtual puppetry that he discusses: in each case, Kaplin envisions the creation and/or manipulation, by one or more persons, of computer graphics figures. It is also worth noting the ease with which Kaplin writes of these figures as puppets. There seems to be an implied definition of puppetry here, which runs: if the signification of life can be created by people, then the site of that signification is to be considered a puppet. This definition—which, I should emphasize, I have read into Kaplin's essay—is revolutionary, expanding the realm of puppetry beyond all definitions that center upon the materiality of the puppet (or, to employ Benjamin's terms, the "unique existence" of the puppet as an object in a "specific time and place"). It would seem to encompass not only computer graphics images (and stop-action and all animatronics as well), but also forms of art that have been almost universally held distinct from puppetry, such as the cel (also known as cell) animation popularized by Walt Disney.

Media figures share with puppetry the crucial trait of presenting characters through a site of signification other than actual living beings.

Our efforts to make sense of the relationship between media figures and puppets as we know them, stimulated as these efforts might be by categorical statements (and implications) of one kind or another, must derive ultimately from an understanding of what media figures actually are. To that end, we will do well to attend to the details of such figures, looking especially at how they are created and controlled.

Computer graphics figures, such as the Hamlet I mentioned at the start of this essay, involve, in effect, three processes of creation. First, a three-dimensional abstract model of the figure is created in the form of multiple polygons or a digital wire-frame;[4] the model can be constructed from the computer keyboard (by which term I also include the computer mouse) out of geometric shapes and/or lines, or can be imported into the computer through three-dimensional shape-capture (the "capturing" of the look of a real-world object). I created the model for my Hamlet from the keyboard, using geometric shapes that I stretched and "deformed" into an approximation of the shape of human limbs and then linked together; the model for the head of *Toy Story*'s Woody, on the other hand, was based on a clay sculpture whose shape was captured by being scanned into a computer (Pixar/Walt Disney Pictures 1995:8). There are, I need scarcely say, extremely sophisticated computer programs, commercially available, that include "resident" polygon and/or wire-frame bodies (some constructed, some captured from life) and therefore greatly simplify the task of constructing a model.

Designed into the model of the figure are the means for controlling its gestural movement;[5] these are known as "articulation variables" (or, more casually, as "avars"). One writer likens the avars to "the strings of a marionette" (Pixar/Walt Disney Pictures 1995:6), but they are actually more like the articulation points of puppets as we have known them; indeed, computer graphics programs offer a selection of joint-types quite like those available to the puppet-builder, including hinge joints, spherical (ball-and-socket) joints, and so on, all of which can be defined for their stiffness and range of movement. The number of avars that might be involved in a complex model is astonishing: the model for *Toy Story*'s Woody had 212 avars in his face alone, 58 of which were dedicated to his mouth, allowing him an exceptional range of expression and a capacity for shaping his mouth for each particular phoneme he would speak (8).

The second process in the creation of a computer graphics figure is the definition of surface features for the geometric model or wire-frame. The surface features might be selected out of individual characteristics of color, texture, pattern, and reflectivity that are resident in the computer graphics program (and are known as "shaders"), or might be imported into the computer through image-scanning (e.g., the "capturing" of real-world images such as photographs). I created my Hamlet's surface features out of resident characteristics; the computer graphics figure of *Men in Black*'s Jack Jeebs, on the other hand, has the surface features of the "real" actor (in makeup) who also plays the character (Pourroy 1997:20). The third process in creating the figure is known as "rendering," and is the frame-by-frame compositing of the model and its surface features, along with the definition of one or more light sources and whatever worldly effects, such as shadows and fog, and camera effects, such as lens flare and depth of focus, are desired.

Now if the avars of a computer graphics figure are like a puppet's articulation points (i.e., joints), we must ask what control mechanics are used to create movement at those points and how those mechanics are themselves operated. Or, to put the matter in terms of a marionette, what are the "strings" and how are they "pulled" to give the computer graphics figure its frame-by-frame movement (generally referred to in the computer world as "animation")? Two kinds of movement are relevant here: gestural movement, which, as I have already explained, is movement pertaining to the "body" of the figure; and proxemic movement, which is movement of the figure as a whole from one virtual location to another.

There are, in effect, two basic control mechanisms, each deriving from a different source of control, although in practice these mechanisms and sources are often used in combination. The first mechanism is known as "kinematics," and its source is the computer keyboard. Until a few years ago, "forward" kinematics were accomplished by defining a figure's movement at each avar, generally working from the larger to the smaller limbs. For example, to have a figure touch its nose, one would enter commands first to rotate the upper arm, then the forearm, then the finger that would touch the nose (with each rotation occurring at an avar). Recently, however, the development of "inverse kinematics" has allowed one simply to attach a "handle" to a certain part of the figure, "grab" it with the computer mouse, and "drag" it to its desired location, with the necessary movement at related articulation points following naturally along, the various joints operating according to their defined stiffness and range of movement. To have a figure touch its nose, for example, one need only grab a handle at the figure's fingertip and drag it to the nose; the wrist, elbow, and shoulder (and, if desired, the upper torso as well) will rotate accordingly. Inverse kinematics, thus, has made the gestural-movement mechanics of computer graphics figures truly analogous to the strings or rods of puppets as we know them.

Once a gesture has been "defined," it can be saved for later use in the computer's memory: once one has defined nose-touching, say, or the movement of the lips for the phoneme "em," one can easily recall it for usage as often as one wants. More complex gestural movements such as walking require the integration of multiple movement definitions, such as for the arms and the legs. The task is slightly less complicated than it might seem, however, since the movement defined for one limb can be recalled (and "flipped," if necessary) for its opposite; also, inverse kinematics will allow certain aspects of the movement to follow naturally. On the other hand, the walking gesture of a well-made computer graphics figure involves far more than the motion of arms and legs: there are myriad details to consider as well, including patterns of breathing, the flexing of individual muscles, and so on.[6]

Proxemic movement is generated from the keyboard primarily through the definition of "animation paths," in which one describes the route that the figure will take from one location to the next. The speed at which the figure will move is a function of the number of frames that it will take to traverse the distance, and must also be defined. Since computer graphics figures exist in a three-dimensional virtual space, their animation paths can take them in front of objects, thus "blocking" the objects from view, or behind them; also, as they move "toward" or "away from" the virtual "camera," they will appear to grow larger or smaller, respectively. Another approach to proxemic movement involves defining certain "physical" qualities for the figure, such as center of gravity, weight, and rebound characteristics (e.g., like rubber, steel, etc.). The figure can then be dropped, as it were, or tossed or spun, and it will act in accordance with its defined qualities.

To create from the keyboard the walk of a figure across a room—as I created the walk of my Hamlet—involves the bringing together of separately defined gestural and proxemic movements: first one uses handles to define the gestures that constitute walking, and then one defines the animation path and speed of the walk. This bringing together of movements is analogous to the way that puppets are moved. A marionette, for example, also has specific gestures of walking, created primarily with its leg strings; these walking gestures are brought together with a proxemic path along which the marionette is transported by its main support strings. If, at the end of the computer graphics figure's walk, one wanted to have it collapse on the floor, one could simply let it drop freely, with its fall governed by its defined physical qualities; likewise, a marionette would collapse to the ground, according to its real physical qualities in the natural world, with a sudden slackening of the tension on its support strings. The main difference between the keyboard-created walking of a computer graphics figure and a puppet is that the walk of the former is painstakingly composed over an extended period of time, while the walk of the latter is created all at once, in real-time.

The second control mechanism for the movement of computer graphics figures is known as "motion-capture," and the source of control is the human body. Motion-capture refers to the digital "capturing" of real-world motion-gestural and/or proxemic—for its application to the computer graphics figure. The "capture" itself is made possible by a series of tiny transmitters or reflectors that are placed on a device manipulated by the performer; alternately, the transmitters or reflectors can be placed directly on the performer's body, and the body itself "manipulated," as it were. In either case, the transmitters or reflectors are mechanically, magnetically, or optically tracked for their exact motion; analogous points are defined for the figure that will be moved.

The most well-known motion-capture device is the "Waldo" (a name trademarked by The Character Shop), although the principles behind the Waldo are in wide usage. The Waldo is advertised, perhaps with tongue partly in cheek, as an "ergonomic-gonio-kineti-telemetric device." "Ergonomic" means that the device is engineered to fit ("comfortably") the performer's body; "gonio-" and "kineti-metric" mean that it "measures the angle and movement of the wearer's joints and limbs," or, for that matter, the lips, eyes, or whatever; and "telemetric" means that "the movement data is [*sic*] measured and sent via remote control" to the computer. The digitized data are then applied to the computer graphics figure, with the result that the figure's "movement" echoes, in "real-time," that of the performer.

Waldoes, according to Character Shop literature, seem to be concerned primarily with gestural movement and, indeed, offer two ways of controlling such movement. The first might be termed a "physiognomic analogue," and involves a one-to-one relationship between the body of the performer and that of the figure: the opening and closing of the performer's mouth results in an analogous movement by the figure's mouth. The second way of generating gestural movement might be called "movement analogue," and involves a one-to-another relationship between the movement of a particular part of the performer's body and that of a different part of the figure: the opening and closing of the performer's hand, within a device rather like a standard Muppet (or a hand-in-sock puppet), results in the opening and closing of the figure's mouth.

There seems to be an implied definition of puppetry here, which runs: if the signification of life can be created by people, then the site of that signification is to be considered a puppet.

Proxemic movement can also be generated through motion-capture. Polhemus, Inc., for example, advertises a motion-capture system that allows two performers to "interact together [...] and to move freely within a 25 foot by 50 foot space" (Polhemus 1997). Indeed, given that this system can involve up to 32 receivers (placed on the performers' bodies), it can be said to track much of the gestural movement that naturally occurs along with proxemic movement. There is a paradox here that might be worth noting. Movement generated from the keyboard is, as we have seen, unlike puppet movement in that it must be painstakingly composed over a long period of time. It is, however, quite like puppet movement in that its gestural and proxemic aspects are generally treated as individual problems. Movement generated through motion-capture, on the other hand, can be quite like puppet movement in that it is generated, in real-time, through the bodily exertions of a living being. It is, however, unlike puppet movement in that its gestural and proxemic movements need not be treated individually, but can be dealt with all at once.[7]

Motion-capture not only allows for real-time control of the computer graphics figure, but, with recent developments, now allows even for the kind of virtual "live" performance (i.e., a synchronicity of control, performance, and reception) referred to earlier as "performance animation." Silicon Graphics, Inc., for example, has been among the pioneers in performance animation, which they can characterize as the use of motion-capture applied to a computer graphics figure that allows the figure (on a video screen) to interact with a live audience.[8]

Should computer graphics figures be considered puppets? We recall that Levenson would exclude them if only on the basis of the use of technology in their creation, while Kaplin predicates his entire discussion of new subgenres on their inclusion. The question might best be approached by breaking it down into two distinct issues: the nature of these figures and the relationship between them and their operators.

In dealing with the first issue, it will be helpful to make use of the concept of tangibility, with the root-sense of "tangible" being "capable of being touched." Computer graphics figures are not tangible—there is no touchable "there" to them. As we have seen, there are striking similarities in the creation of computer graphics figures and puppets: the creation of both involves the construction of a figure imbued with articulation points that is then given surface design features. Both, in short, are artificial human constructs designed for manipulation (of one sort or another) by people. And, as I suggested earlier, both share the crucial trait of being sites of signification other than "real" living beings (or of images that are directly referent to such beings); that is, in both cases the signs of life have been abstracted from sites of actual life to be deployed by sites that have no actual life. On the other hand, however, even if a figure's model were to be derived from 3D scanning (e.g., a clay sculpture), and even if its surface features were to be imported from a tangible source (e.g., an actor's face), the figure itself would remain without tangibility—a "virtual object" that would be, at most, an indirect referent to material or corporeal objects. Now it might be argued that the conventional film or video image of a traditional puppet or an actor is also without tangibility, but in such a case, the image is a direct referent to a material or corporeal object, notwithstanding the ways in which directors and editors might make use of that referent.

Here then is a point that seems to be of fundamental importance: puppets as we have known them—fabricated out of wood, cloth, the much lamented celastic, or whatever—are tangible objects, while computer graphics figures are not. This difference provides sufficient theoretical basis, despite the many similarities shared by these two kinds of figures, for distinguishing between them. But I think the distinction needs to be more subtly put than simply to declare puppets and computer graphics figures to be intrinsically different, because tangibility seems to be the only significant and invariable difference between these two kinds of figures. Thus, I propose that puppets as we have known them be thought of as "tangible" puppets, while computer graphics figures be thought of as "virtual" puppets (to borrow Kaplin's term). These usages will, I think, assuage traditionalists such as Levenson, since the semantic overtones of the modifiers "tangible" and "virtual" are, respectively, "real" and "not-quite-real," and reflect the fundamental difference between the two kinds of figures. But I trust these usages will also satisfy visionaries such as Kaplin, since the shared employment of the word "puppet" recognizes crucial similarities between the two kinds of figures. Computer graphics figures—virtual puppets—are, as I have suggested, conceptually new and owe their conception to the newness of the medium in which they exist; but as with everything new, they are not at all unassociated with what has gone before them.[9]

If I am willing to accept computer graphics figures as virtual puppets before I even address the issue of the figures and their operators, it is because this issue—generally cast in terms of "real-time" control by the operator—seems to me to be a red herring. As a rule, tangible puppets are operated in real-time; as we have seen, however, virtual puppets might also be operated in real-time—indeed, even "live."[10] One respondent to Levenson's proposal suggests that the criterion of real-time operation is significant in discussing computer graphics figures because the control of them "lacks the possibility of mistakes—mistakes being the arbiter of good and bad performance" (Levenson 1992:3). Even for live performance, this seems a strange criterion: certainly the making of mistakes will mar a performance, but just as certainly a great performance can contain more mistakes (a flubbed line, a misplaced prop, etc.) than a mediocre performance that is errorless but without passion or intelligence. More to the point, the very idea of mistakes seems obsolete for all non-live performance, whether mechanically reproduced or produced through media: mistakes can be edited out or relegated to unused "takes" just as easily as they can be "erased" in media production. And, as a matter of fact, mistakes remain in all kinds of non-live performance when the replacement of those mistakes does not seem worth the cost and/or effort.

The issue of real-time control seems less an issue of "What is a puppet?" than one of "What is a puppeteer?" A person operating a puppet (tangible or virtual) in real-time is palpably doing what puppeteers have always done; but a person working at a keyboard with a virtual puppet—despite the fact that one is controlling the movement of the puppet—does not seem to be engaged in the same activity, despite the fact that the result (i.e., movement of the figure) is the same. This leads us to a paradox: the prospect of puppetry (or of virtual puppetry, at any rate) without recognizable puppeteers. Computers have, one might say, freed the puppet from its dependence on conventional puppeteers. But computers have not, of course, freed the puppet from the necessity of human control of one sort or another—only from the real-time control of the puppeteer.

> To create from the keyboard the walk of a figure across a room involves the bringing together of separately defined gestural and proxemic movements: first one uses handles to define the gestures that constitute walking, and then one defines the animation path and speed of the walk.

Pursuant to the line of reasoning I have been developing, it might now be worthwhile to consider the other kinds of media production mentioned near the beginning of this essay: stop-action animation and animatronics. Indeed, it will be best to begin with at least a brief consideration of a form of media production I have noted only in passing: cel animation.

As we have seen, Kaplin's implied definition of puppetry provides no apparent grounds for excluding cel animation from the realm of puppetry. Does it have a place within my framework of tangible and virtual puppetry? I suggest not, and make this suggestion without taking recourse to the criterion of real-time control. The principle behind the movement of cel-animation figures is fundamentally different from those of tangible and virtual puppets. Cel-animation figures, owing to their nature as works of painterly art, have neither articulation points nor control mechanics of one sort or another, as do both tangible and virtual puppets. In fact, their movement is not really "controlled" at all, but is strictly an optical illusion: they do not "act" like puppets, but like the drawings they are. While I would not hesitate to recognize an affinity between cel animation and puppetry—especially since each sites the signification of life in a place that is not life itself—I think that their differences require them to be considered as different forms of art. The figures of cel animation are obviously what I have termed media figures, since without technological mediation they cannot "act" in the least; not all media figures, however, need be thought of as puppets.

Turning now to stop-action figures, a brief glance at their history will establish them as the chronologically earliest of media figures. J. Stuart Blackton made use of them in a 1907 short, *The Haunted Hotel*, and they had an extended vogue in Russia, in the films of Ladislas Starevich as early as 1912 through Ptushko's 1935 *The New Gulliver*. They appeared in the 1933 classic *King Kong* and the Czech filmmaker Jiri Trnka employed them to great effect in a series of films in the post–World War II era. They are also long familiar, of course, in American television, having been used for such staples as Gumby and the Pillsbury Doughboy (Touchstone Pictures 1994:4). Given their early history, it is interesting that Benjamin made no mention of them—but if he had, he would have had to reconsider his thesis that film can only reproduce (and so, dislocate) works of art, for stop-action provides a classic case of technology being used to create original productions.

The basic principle of stop-action animation will be familiar to most readers: A material object without any visible means of control is set in a particular pose and shot with a single frame of film. The figure is then given a minutely different pose, the film is advanced, and another single frame is shot. And on and on, until the finished sequence of frames, when viewed at projected speed, gives the illusion that the figure is moving of its own accord, while in fact, the film does not actually record any movement, per se, of the figure, but only a sequence of still positions. Stop-action figures belong, I suggest, to the new breed of media images because, despite the relatively old technology used in their creation, they are quite literally the creation of that technology. They are not, that is, "mechanical reproductions," for their visible movement is not being reproduced at all, but produced for the first time through the medium of film.

Stop-action figures are material objects in precisely the same sense as tangible puppets: the principles of their construction are identical to those of such puppets, involving the fabrication of a body that is imbued with articulation points and given surface features. What differences exist in construction are of degree rather than of kind. Most importantly, the stop-action figure will usually be given more articulation points than is common in puppets: the centipede in *James and the Giant Peach* (1996), the most complex of the figures used in the film, has 72 such points (Disney Studios 1996:8). Two additional differences are also worth noting. First, a figure will frequently be given a set of interchangeable heads: the title character in *James and the Giant Peach* has 45 different heads, each of which has a particular base expression and set of articulation points (5). Second, a figure might be created in multiple versions, to be used variously depending on the demands of the shot: 15 different figures were fabricated for each of the seven leading characters in *James and the Giant Peach* (5). These characteristics of stop-action figures—extra articulation, interchangeable parts, and multiple figures for the same character—are not, however, required for the creation of stop-action, and are really only elaborations of practices that are available with tangible puppets.[11]

Are stop-action figures puppets? The actual manipulation of such figures is quite similar to that of tangible puppets, being nothing more or less than the physical moving of various parts from one position to another. The difference between stop-action figures and puppets, which is significant and invariable, is that by the very process of their animation, stop-action figures cannot be operated in real-time, or in anything close to it. In *The Nightmare Before Christmas*, "a typical shot would take three days [to create] and end up lasting about five seconds on the screen" (Touchstone Pictures 1993:3). The manipulation of a stop-action figure does not take place in front of the audience (or of the film camera that is the stand-in for the audience), but is, quite literally, hidden away, taking place as it does between the individual frames of film. What the audience sees, as it views a stop-action film, is not the recorded image of movement, but the illusion of movement created through the recording.

Stop-action figures, I suggest, are puppets to the same degree as computer graphics figures; that is, they are closely related to puppets as we have known them except in one crucial regard that arises from the newness of the medium in which they exist. It was relatively easy to discount the issue of real-time control when speaking of computer graphics figures, since such figures can be controlled either in real-time (e.g., through motion-capture) or not (e.g., from the keyboard) without any significant difference in the figure's movement. When speaking of stop-action figures, however, it is not so easy to overlook the matter, since the absence of even the possibility of real-time control is the defining characteristic of these figures. It will be more useful, however, to think of the difference not in terms of real-time, per se, but rather in terms of the tangibility (or lack thereof) of the movement given to puppets and stop-action figures: one sees a puppet actually move, but all one can see with a stop-action figure is the effect of its movement.

I am suggesting that we think in terms of a third category: tangible puppets, virtual puppets, and stop-action puppets.

Just as I have proposed distinguishing between the tangible and the virtual puppet on the basis of what I take to be the only significant difference presented by the latter (i.e., its lack of material tangibility, which is a function of its medium), so I now propose to distinguish between the tangible and the stop-action puppet on the basis of the only significant difference that exists between them: the stop-action puppet's mediated illusion of movement. I am suggesting, that is, that we think in terms of a third category: tangible puppets (i.e., tangible objects that are tangibly moved), virtual puppets (i.e., intangible objects that are tangibly moved), and stop-action puppets (i.e., tangible objects that are intangibly moved). As with the distinction drawn between tangible and virtual puppets, I hope the distinction I now draw between tangible and stop-action puppets will be strong enough to mollify the traditionalists who want to emphasize the uniqueness of puppets as we have known them, but will also encourage the recognition of the basic similarities between the two kinds of figures.

It remains to offer a few words on animatronic figures, a subject on which I can be relatively brief. Animatronic figures, by which term is meant figures whose control is based on electronics transmitted through wire and/or radio signals, are tangible puppets, as a rule, having both material and movement tangibility. The fact of their electronically based control renders them a distinct type of tangible puppet (along with other types such as hand puppet, rod puppet, etc.), but this is a minor matter compared to the differences that exist between tangible, virtual, and stop-action puppets. It is worth observing that animatronic puppets differ from many other tangible puppets in successfully obscuring their control mechanics and in attaining an exceptional degree of verisimilitude—they generally do not "look" like puppets—but these are differences of degree and not of kind. It is also worth observing that animatronic puppets might be controlled either through the computer keyboard or motion-capture (or both together, sometimes supplemented by more traditional means as well, such as strings and rods), but that in either case their movement is tangible, so that one need not be concerned with the red herring of real-time control.

There are some animatronic figures, however, that need to be differentiated from puppets: these figures are automata, such as the aforementioned characters to be found at Disneyland, or the disagreeably raucous creatures at establishments such as the Chuck E. Cheese pizzerias. The distinguishing characteristic of the automaton is that its movement possibilities are "closed." With puppets of all kinds—even those with a limited range of possible movements—the nature and duration of each movement is open to the control of the operator, whether the operator sits at a computer, wears a Waldo, or squats behind a playboard. With an automaton, however, the program of movements, once laid down either electronically or mechanically, is invariable: first it will nod its head, let us say, then wave a hand, then rise in greeting, and so on. The automaton's program might indeed be altered, but it then would have only a new invariable program. The difference between puppets and automata is not the function of a new medium of presentation, as are the differences presented by virtual and stop-action puppets; thus, a distinction should be maintained between the automaton and all categories of puppet, with an automaton (whether controlled through animatronics or mechanics) being considered a kind of kinetic sculpture.

Tangible puppets, virtual puppets, stop-action puppets (and the use of animatronic controls for any or all of them as well): What, finally, is one to think of the art of puppetry in the age of media production? Back in the age of mechanical reproduction, Walter Benjamin's thoughts seem to have verged on the apocalyptic: he concludes his essay with the strong implication that mechanical reproduction is associated with fascism, and thus with war ([1933] 1969:241–42). While I am certain that media production is a function of, and an influence upon, contemporary society, I hesitate to draw any profound conclusions from its development. Rather, I think it has developed simply because its development was possible: artists saw some possibilities in the new media and rushed to take advantage of them, just as they have always done when presented with new possibilities.

Traditionalists such as Mark Levenson (at least in his formal role with UNIMA-USA) seem to fear for tangible puppetry in the face of the various kinds of media puppets, and so seek to maintain a sphere of exclusivity for it. Visionaries such as Stephen Kaplin are more sanguine. The new forms of puppetry, writes Kaplin, will not mean "death of traditional [forms of] puppetry," but will probably lead them to be "preserved for their historic, spiritual or folkloric value, like endangered species on a game preserve" (1994:39). Such preservation does not seem to me like a terribly happy fate; but neither does it seem likely. One is hard pressed to name three traditions of puppetry that have successfully been "preserved" after their audience has deserted them.[12]

In fact, however, I do not think that media puppetry spells the end of puppetry as we have known it. There is a pleasure still to be found in the live performance of a tangible puppet—the direct confrontation between an audience and a "living" object—that is distinct from the particular pleasures of media puppets. I foresee a future in which tangible puppets and media puppets can coexist, each stimulating and challenging the other. My virtual Hamlet is not itself of nature; neither, in its own way, would be a stop-action Hamlet. But both, just like a marionette Hamlet or, for that matter, a living Hamlet, serve the same essential function (albeit by differing means): not so much the holding up of a mirror to nature as the opening up of a window for human artistry.

Notes

1. I created this figure using a computer graphics program called Caligari truSpace; see <http://www.caligari.com/>, where a demonstration version of the program is available as of this writing. A series of powerful computer graphics programs are also sold by Alias | Wavefront. My discussion of computer graphics below has been greatly informed by the literature, available on the Web, put out by these two companies, as well as by Web literature from Silicon Graphics, Inc.
2. See my "The Actor Occluded: Puppet Theatre and Acting Theory" (Tillis 1996) for a discussion of signification siting.

3. See, for example, Weissberg (1996).
4. Although I speak of the model as being "three-dimensional," it should be understood that I refer to three dimensions within virtual, not real, space: the computer screen image of the model has, literally, only two dimensions.
5. By "gestural movement" I mean all movements that pertain to the "body" of the figure, from gross movements such as walking and jumping up and down to exceedingly fine movements such as the twitching of a muscle.
6. It might be noted that another approach to creating gestural movement from the keyboard involves defining certain closely related poses rather than actual movements. Using a shape-shifting program (such as the ones that are used for "morphing" one person's face into another's), these poses are then blended together in sequence to create the movement.
7. It is, perhaps, not surprising that a tension exists between practitioners of keyboard-generated movement and those who work with motion capture. Richard Cray, in a personal correspondence (1997), writes that Steph Greenberg, of Walt Disney Productions, has referred to motion capture as "Satan's Rotoscope."
8. Among the people (and companies) instrumental in developing performance animation, in addition to Silicon Graphics, are Brad deGraf (Protozoa), Michael Wharman and Chris Walker (Mr. Film/Modern Cartoons), David Sturman (Media Lab), and Mike Fusco (Simgraphics). Richard Cray's website for the Performance Animation Society (www.PASociety.org) has perhaps the fullest set of web-links available on the subject of performance animation.
9. I should at least note a pair of possible arguments concerning tangibility. It might be argued that computer graphics figures are not just like, but are the same as, shadow puppets—both being images on a screen—and that therefore there are no grounds for distinguishing at all between such figures and puppets. But *contra* this argument, while the shadows in shadow puppetry are indeed only images, the puppets in shadow puppetry are not the shadow images themselves, but the tangible puppets—the material entities—that are the direct referents of the shadows. Also, it might be argued that computer graphics are just like tangible puppets after all, since they are predicated on the tangibility of the computer screen or the projector screen. But *contra* this argument, neither of these screens is actually the computer graphics figure; they are only the tangible surfaces by which the puppet—which itself has only a virtual "existence" as a computer code—is made visible.
10. The origin of a real-time criterion for puppetry seems to have originated in a desire to distinguish between puppets and automata. See below for a discussion of this issue.
11. The overall effect of these distinctive aspects of fabrication is to allow the stop-action figure a far more detailed level of movement than is typical for even the most articulated marionette. One might note, however, that for all of the possible nuance of its movement, the stop-action figure will still lack the articulation of a well-designed computer graphics figure: Woody, in *Toy Story*, has a remarkable 712 avars (Pixar/Disney Pictures 1995:8).
12. Consider the fate of the karagöz shadow theatre, for example, despite the cultural preservation efforts of the Turkish government.

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