

Invited paper, submitted for the volume: Janina Wildfeuer and John A. Bateman (eds.) "Film Text Analysis". Series: Routledge Advances in Film Studies series, 2016.

Wolfgang Wildgen

Movie physics or dynamic patterns as the skeleton of movies

“a filmmaker isn’t supposed to say things, his job is to show them”
Alfred Hitchcock in an interview with François Truffaut (Truffaut, 1968: 113)

1 Introduction: Is there something to explain in movies?

If a spectator comes home from cinema he/she may rehearse the story, the sequence of major events, spectacular action scenes, the climax, and the (happy) end. The major characters, the beauty/sexiness of the female protagonists, the cleverness of the hero or the villain may come to his mind. But is he/she keen to understand, let alone being able to explain the picture? Probably not. Who is then the addressee of an analysis of films? A student of cinema, who is preparing for his own activities in the field, either as cameraman, script-writer or director, may ask more specific questions. Truffaut who started as a film critic and later produced his own films asks the question: *Mr. Hitchcock, how did you do this?* In his interview with Hitchcock in 1966 (cf. Truffaut 1968), the author is particularly interested in the question: *How to express oneself with purely visual means?* What counts is not the story which may derive from some novel or newspaper report, but the visually offered information and emotions. Contrary to novels, a movie does not primarily tell us what has been spoken, said, or told by the protagonists. The minor relevance of language for movies had previously been demonstrated in the era of silent pictures and Hitchcock and Truffaut argue in the interview in favor of silent pictures:

“Hitchcock.: Well, the silent pictures were the purest form of cinema; [...] Truffaut.: In this sense one might say that mediocrity came back into its own with the advent of sound. Hitchcock: I agree absolutely [...]. When we tell a story in cinema, we should resort to dialogue only when it’s impossible to do otherwise” (Truffaut 1968: 49)

In a sense, sound as noise in the environment and as language spoken is just an index of our acoustic environment; it may reinforce the visual impact, but cannot replace what we see with

our eyes. What is important is the attention of viewers, which must be guaranteed at any time, and this attention is mainly visual. Linguistic information may even deteriorate this attention and the effects of surprise and suspense, which are central for the success of a picture.¹ Beyond bodily action, dialogue may be relevant as a kind of social action. It is simultaneously a visual process, which includes gazing, posture, and other paralinguistic cues. The fundamental filmic techniques had been formed in the era of silent picture, mainly with and after Griffith. The position and mobility of the camera, i.e. the filmic viewpoint is the major difference to the theatre where the classical proscenium viewpoint dominates. By the use of different cameras and by montage, the spectator can change his/her position in relation to the reported actions. He or she can adopt subjective or objective viewpoints. Hitchcock asks for “realistic viewpoints”, i.e. those which a human viewer can normally take or imagine taking (Truffaut 1968: 77). If a close-up is necessary, he introduces (in “Rear window”) the glasses of the main figure Jeffrie (James Stewart) as a natural cause for the change of focus. In general, he respects the natural affordances of the environment. Thus Jeffrie is by his profession press-photograph and in his situation of immobility he uses his normal instruments: glasses, cameras (with flash in the defence scene), and the telephone. His observation through the window corresponds to normal human behavior in similar situations (“We are all a race of Peeping Toms”). Thus natural observation, curiosity, the interpretation of body cues, postures, faces, eye glances, and gestures are transferred into techniques of the camera and the construction of shots. But this is not enough. As soon as pictures became longer and took over a narrative function, thus rivaling with language and literature,² this demanded a specific economy of visual display. This had three major consequences:

1. Pieces of visual information had to be packed and later reassembled into a plot by montage. The technique of cuts, i.e. small structural sequences, which correspond in their duration more or less to sentences (5 to 15 seconds; cf. Truffaut 1968: 148), may have been copied from linguistic codes. Or they also correspond to the more general cognitive principles of economy in relation to short time memory and closure enabling

¹ See Liu (2007) for a computational analysis of attention in movie audiences.

² In the history of modern music, one can find a similar constellation at the beginning of the 20th century. When Arnold Schönberg (1874-1951) and others introduced the technique of 12-tone scales and seriality, their repertoire of musical forms was first small and only short pieces were possible. With the help of parallel texts, songs and dramatic (linguistic) plots larger compositions became accessible. Thus narrativity rooted in language routines was used as a means to create compositions which were able to catch the attention of a public for a longer period.

larger constructions (texts, discourses etc.).³ Larger pieces may constitute “little films in themselves” as Hitchcock points out to Truffaut in the interview (Truffaut 1968: 75). In *ROPE* (1948), Hitchcock tries to match the picture time to the event time (7:30 to 9:15) and he uses the maximal length, i.e. the 10 minutes of a film reel. In order to maximize the impression of time continuity, Hitchcock even applies a trick: one reel ends with a close on the black jacket of someone, while the camera team is changing to a new reel, which starts with the same black surface.⁴

2. The reassembling of the pieces is primarily done by montage. Hitchcock had already had a good experience with montage in the era of silent pictures before he became a film-director. He worked on titles in silent pictures. With the choice of titles (captions often accompanied by a drawing) the story of the silent picture could be modified, even from a tragedy to a comedy and vice-versa and bad performances of actors could be made acceptable (cf. Truffaut, 1968: 24-25). Later, the way he had conceived and realized the pieces of the picture were such that he was the only one who correctly assembled them. In a certain sense no one else even knew how the whole story would look like. This guaranteed that the producer or other authorities could not freely use his material to produce a picture which did not map with his plan and purpose. The assembling by montage does not just produce a serial order out of a heap of film materials; it follows on from a kind of plan or diagram. The story board, of which Hitchcock had training as an industrial designer, visually included camera views of important moments and the basic sequence of shots. It is akin to a comic strip and the visual technique of stories in comics had a major influence on the visual construction of filmic plots.

3. Normally, movie time has only a very indirect relation to real time. Flashbacks may even reverse the direction of time. It is not an easy task to visually mark the difference between ongoing action time (even if it is presented as a sequence of temporal bits) and past episodes rehearsed by memory or even with dreamt episodes. Propositional attitudes such as: *He said, I thought* etc. cannot be shown visually. Timing is also vital in the clarity of understanding from the perspective of the audience. Thus, a newly introduced element or piece of event must be properly

³ In auditory perception this would correspond to the “extended present”, where perceptual units at the lower level (up to 3 seconds) are sequentially ordered. It is assumed to reach its maximum after 10 to 30 seconds (cf. Kühl, 2007: 104 and 107-108).

⁴ In theatre, pauses between acts subdivide the story into two, three, or four pieces and the audience can reflect on the play, talk about it, etc., before the play is resumed. This is not done in films and the producer must try to sustain the attention of the audience with the means of surprise and suspense.

prepared. In a famous scene of *NORTH BY NORTHWEST*, Gary Grant stands lost in a bare landscape, without dialogue and music. Eventually, when a car arrives and a farmer begins to wait for his bus on the other side of the road, a short dialogue introduces the topic of the crop plane, which suddenly shows up and tries to kill the protagonist.⁵ In this scene the pace of visual information is adapted to the velocity of the spectator's understanding. When the plane attacks, Grant escapes and finally hides in a corn field. In this scene the timing corresponds to realistic laps of time in relation to the distance and speed of locomotion. Thus, the dynamics of motion and action are the structural anchor, whereas the psychological timing reflects the cognitive processes in the audience.

These general remarks could make us believe that pictures are the product of intricate constructions and finally movies could just be “fakes”, as the film *F for fake* by Orson Wells suggests. I intend to portray how movies have an inevitable realistic grounding, which is also necessary for the understanding of very fictional, let fantastic plots. I will call this foundational level *movie physics*. Hitchcock used the term of “mechanics of film”, referring to the movie “Secret Agent” (Truffaut 1968: 185).⁶ In section 2 I will discuss the relation of “movie physics” to “semiophysics” (as proposed by René Thom), to the kinematics and dynamics of action and to the question of realism in movies. Section 3 will focus on action movies with a special emphasis on action in James-Bond movies.

2 Physical dynamics and *movie physics*⁷

Dynamics (and kinematics) lies at the heart of modern natural sciences: Galileo laid the fundamentals of kinematics, Kepler stated his laws of planetary motion and Newton formulated the basic principles of modern physics (in 1687) which were understood as universally valid until Einstein published his ideas on special relativity in 1905. Galileo's relativity principle states that velocity is relative to an inertial system. Acceleration and the

⁵ The long scene is a classical MacGuffin (see below for further explanation), because there is no visible link to the overall story besides the fact that the hero is in danger.

⁶ Hitchcock had a training as engineer before he started his movie-career. In the interview with Truffaut he said: “I had acquired some practical knowledge of force and motion” (Truffaut, 1968: 23). The term “physics” was used in the context of comics (“physics of comics”) for a genre which does not have the technical realism of photography (cf. for the field *portrait, photography, comics, and movie*, Wildgen 2013a: chap. 7)

⁷ Some aspects described in the following sections have been treated in Wildgen (2014) and further developed in Wildgen (2015).

forces (counter forces) which govern it are the dynamic reality we are concerned with.⁸ Classical examples of simple dynamic systems are pendulums, which were technically used since Huygens' invention of the pendulum clock in 1656. More complicated are pendulums in a series which transmit force to one another, double pendulums and coupled pendulums.

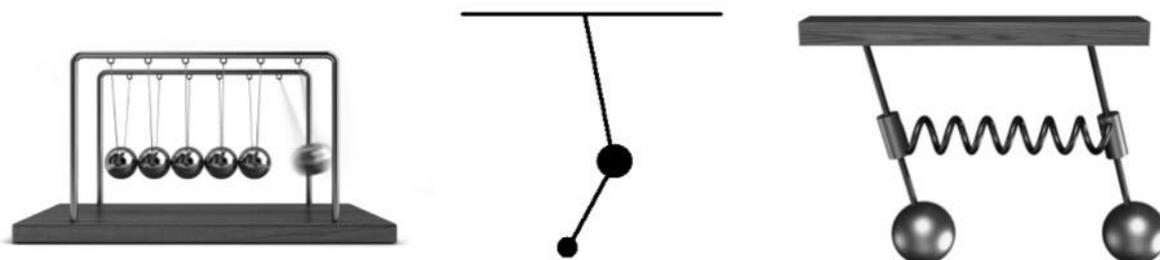


Figure 2.1: Pendulums in a series, a double pendulum and two coupled pendulums

The technical models in Figure 1 give an idea of basic dynamical systems and effects like the transmission of force and forms of coordination/resonance and turbulence (dynamic chaos). Such simple situations become very complex if the balls interact in two dimensions (billiard ball case), if different strength of links exists between pendulums (coordination between partners of different weight) or if the double (triple) pendulum moves in three dimensions. In the domain of living agents, forces alike to those of billiard balls are exchanged by athletes in boxing, coupled pendulums appear if two or four limbs are coordinated in locomotion or in social coordination (building of conventions, rules), arms and legs are basically double pendulums (with restricted freedom). We shall apply these basic concepts in later sections of this paper. In the 80's of the last century, René Thom introduced the dynamic way of thinking into semiotics (and linguistics, science of history etc.).⁹ Mathematics (vector analysis, differential equations, catastrophe theory, etc.) which is successful in dealing with the dynamics in nature are applied to model very basic situations in social interaction and communication.¹⁰ The term *movie physics* has to be understood in this tradition of thought:

⁸ Einstein showed that acceleration is not infinitely variable; it is limited by the speed of light. In the neighborhood of a speed near to the speed of light, the Galileo transformation has to be exchanged by the Lorentz transformation.

⁹ Thom (1990/1988) coined the term “semio physics” (“sémiophysique”). Petitot (1992) used the term “physics of meaning” (“physique du sens”) and established a link to the thought of Kant in his philosophy of nature and his critique of reasoning and to Husserl in his phenomenology.

¹⁰ Classical disciplines which are bridges between natural and human sciences are: *psychophysics*, initiated by Gustav Theodor Fechner in 1860 that influenced the semiotician Charles Sanders Peirce. Modern psychophysics applies quantitative and experimental methods in the analysis of perception and cognition. Another very successful bridge-discipline is *biophysics*, which received a strong impulse with the chemical and molecular analysis of the DNA by James Watson and Francis Crick (Nobel price of medicine in 1962).

forces, counter forces, acceleration/deceleration, effects of forces, the timing of motion and action in moving contexts are put into the center of film analysis. This does not mean that film becomes a proper field of research for physicists; rather that language, film, and media share universal principles which show up in nature and culture. At the heart lies the concept of motion, acceleration, and conflict in space, its perception, memorization, categorization and its representation in sign structures. The specific link between physics and semiotics can be explained by the evolution of animals with vision, audition and brains. In order to survive in a world governed by physical laws, animals and humans had to adapt not only their bodily constitution (e.g. mobility) but also their senses (cf. vision, audition etc.) and, in the sequel, their means of cognition and communication such that their locomotion and action in space/time responded adequately to the physical laws governing their environment.¹¹ This is not the place to elaborate the theoretical aspects of this semiotic approach, which defines the research-line called “dynamic semiotics” (cf. the contributions in Wildgen and Brandt, 2010). I shall rather show its impact in a set of applications mainly to action films, because here motion, chase and flight, fight and challenge dominate the narrative content.

2.1 Dynamics in language and film

In written language, the dynamics are restricted to the sequence of units (graphemes, morphemes, sentences, chapters, etc.). In spoken usage, intonation, rhythm, and emphasis are additional dynamic features. In the case of photos and even clearer in film, the space depicted is two-dimensional (with a simulated third dimension). In classical structuralism, spatial and dynamical aspects are reduced to discrete choices and concatenations. Thus, Metz (1968) argued within the framework of duality: *paradigmatic* versus *syntagmatic*, which Jakobson had established. Each point step in a process is a choice made from a list of alternatives (paradigm); the respective choices are structured under the syntagmatic restrictions of the semiotic system. This may be further reduced to the operation of a machine controlled by a program. The film, however, produces a continuous, multi-dimensional perceptual space and therefore does not fit this simple picture.

Sociophysics was initiated by Weidlich and Haag (1983) who applied the methods of synergetics (cf. Haken, 1983) and statistical dynamics to social systems, e.g. to processes of migration. See for an application in the sociolinguistic context Wildgen (1986). The areas of neuropsychology and physics are bridged in the work of Scott Kelso; cf. Kelso (1995).

¹¹ See Wildgen (2004) for the evolution of language in the context of bodily evolution and physical contexts.

2.2 Film and photography

The history of film is essentially linked to the earlier technique of photography. As Souriau (1969: 126) shows, both film and photo refer to luminosity (“éclairages, projections lumineuses”). Now, many arts refer to visual effects, and thus to light (in Souriau’s table: drawing, sculpture, architecture, painting, dance), but in the case of photography and film, the effects are transitory and the surface on which the film is projected is not changed by the projection. The visual impressions are momentary and thus transient in time (including very elusive memory effects). In this respect, it may be compared to dance and theatre. In its early history, cinematographic techniques belonged to circuses or amusement parks and were on par with magical performances. Their narrative potential was only developed in the period from 1910 to 1915. The generation of Méliès, Porter, and Griffith invented the cinematographic code for filmic narratives. It was only in this period that film acquired what Metz calls a “language of film”, primarily due to the intention of fulfilling narrative functions (thus rivaling novels and literature). In a certain sense, the narrative function is a freeloader of the visual medium film; and movie-art consists mainly in expressing content in an immediate and natural visual technique and not just as an illustration of a story told with linguistic means. The focus of visual media is on the referential function, i.e. on *actions*. They may be decomposed into actions of protagonists and antagonists. The complication phases are driven by chases. Several complicating actions are either ordered serially or in parallel sequences. Action can be accelerated or decelerated. In extreme cases, the movie may either simulate a steady flow or dissolve into a tachistoscope-like sequence of cuts; normal films consumed by a large public avoid these extremes (cf. Biro, 2008).

2.3 The semiotic construction of space in film

The space of the medium is two-dimensional and contains a time dimension. A film in the academy format (rectangular 11:8) emphasises the centre and reinforces the illusion of depth. The broadband format (11:5) emphasises the horizontal dimension, such that landscape and action scenarios become more prominent. Actions and movements in the horizontal dimension of the filmic space can be tracked for a longer period of time without a change of focus. A third dimension of space may be simulated, either by motion into depth or via 3D effects. The direction of view of the person (and the camera) can go down from a balcony, a window in the upper floor into the courtyard, the street, or up into a stairwell or, in a particularly extreme case, rock climbing; it can go into a vertiginous abyss. An example of a movie focusing on the vertical perspective is *Vertigo* (Hitchcock 1958), in which the

perspective down from the bell tower or into the stair case is a dominating topic (see Figure 2, left image). In *North by Northwest* (Hitchcock 1959), the protagonist and his female partner climb Mount Rushmore (below the presidential head figures) and he must rescue her when she is in danger of falling down the cliff (see Figure 2, right image).



Figure 2.2: Screenshots from VERTIGO (Hitchcock1958; left) and NORTH BY NORTHWEST, (Hitchcock, 1959; right); look into the abyss.

Major types of space constructions in movies are:

- landscapes and locations which are carefully selected or reconstructed;
- private rooms: they are used to illustrate the properties of the agents and their spaces of power, they also represent power relations between groups and individuals;
- transitional spaces (passage, transit): in scenes on streets, hotels, trains, airports characteristic paths of actions and the physical and emotional forces operated are visible;
- mazy spaces: actors and audience lose orientation in given space or they only exit safely with difficulty;
- artificial areas (e.g. medially constructed ones) and virtual spaces that are digitally created.

If the movie involves architectural interiors, elements of architecture, such as doors, staircases, windows, narrow corridors, room dividers, and even furniture can create their own framework, thereby structuring the space. Persons can be assigned individual space sectors. These spatial divisions can be repeated when agents move through a suite of rooms. I shall illustrate this topic by mentioning some experiments with movie spaces.

The Danish directors Lars von Trier and Thomas Vinterberg imposed the rules of Dogme 95, which ask for a return to natural conditions of observation via a camera and forbid all kinds of illusionistic manipulations. The film, DOGVILLE (von Trier 2003) takes this minimalist

program to its extreme. The architecture (walls, doors, etc.) is represented by categories (as in language) and not via spatial illusions. The viewer looks through the walls. The abstract scenario can be seen as an antithesis to film technology and fake-construction (see Figure 3, first screenshot). Another film which highlights the phony portrayal of space construction in movies and television is *THE TRUMAN SHOW* (Weir 1998). The basic events occur in an illusory world, whereby the protagonist is eventually able to see and touch the wall and finally exit into the real world (see Figure 3, second screenshot). The agent must discover the amount of falseness and the spectator guesses it early in the picture and is better informed than the hero. This produces a type of suspense (see also next section). The city as labyrinth is a topic in expressionistic films, e.g. *METROPOLIS* by Fritz Lang (1927). The megacity is huge and shows a large population in steady motion. It is subdivided into two classes: those living above and those living below. Human beings move like insects in this huge urban construction. Human action appears meaningless, if it is not a revolt against these conditions of life.

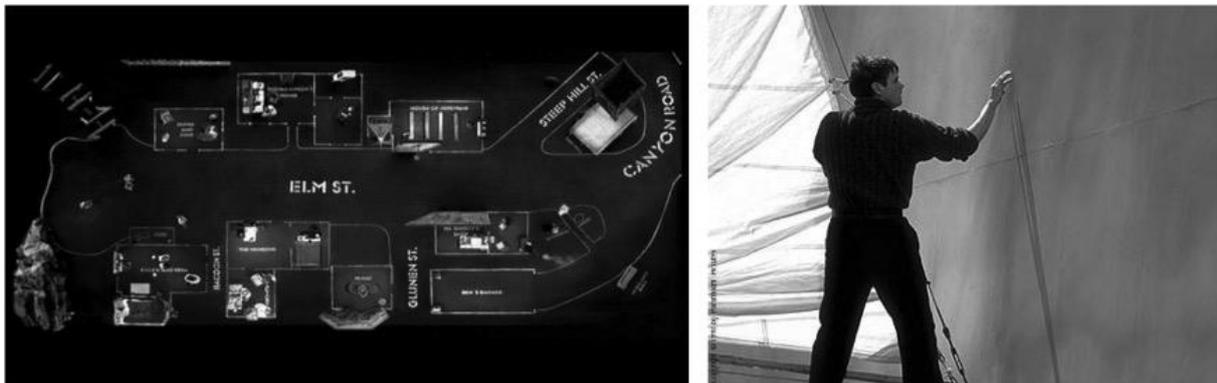


Figure 2.3: Screenshots from *DOGVILLE* and *THE TRUMAN SHOW*

Production designers often have to make great effort to create a place that is suitable for the illusion of the film. This effort is justified because the location of the action is the anchor for all actions and makes them appear credible. In addition, characters and actions only are effective in the context of these places. In a broader sense, this includes costumes and the site-specific behaviour of the characters. In this respect, the basic structure of the film is already given by the construction of places and the control of the events in these places.

In connection with the planning of space, actions may receive specific meanings. The structuring of space, especially by the effect of separating lines and thresholds, produces meaning since it creates bonding structures between thematically related partial fields that are

spatially separated.¹² In films, the transformation of spatial structures is added to the movement of people and the camera. One can even view the movie as the medium of space transformation; see also Pranger (2012) for the history of filmic space constructions. The surrounding space can flow past the moving person as he is being focused in the foreground. This is particularly evident in older Hollywood films and some films of the Nouvelle Vague, where overly long shots of the actors are filmed at the wheel of a car and the driving motion is inserted via an independently filmed background. But movement may also result from the fact that the camera is moving, or via a change of camera focus from a long shot to a close up.¹³ In the construction of meaning, the cameraman substantially contributes (instructed by the director) to the work. The sequence of motion scenes and actions in different spatial segments is done by montage (in the editing room).

Space is not just a static background for events and actions. It allows for specific configurations of action, motion patterns, and accidents. This is clearly the case for means of transportation. The actions play out in or on these spatial domains; but these places are also instruments for the action, i.e., their own movement can be used for actions or can hinder them. The mastery of space and the laws of motion in space distinguish the hero and are the reason for his superiority and his victory at the end of the film.

2.4 Realism in film and the physics of action

The following is an old question in the aesthetics of fiction and theater: How realistic should the story be in order to persuade the reader/public that the content is relevant in the world in which we live and to avoid the impression of unnaturalness, arbitrary construal, and lies?¹⁴ At the end of the 19th century, the triumph of photography and its use in the context of arts together with the literary projects of realism and naturalism triggered a new wave of realism in theatre. The cinema continued and reinforced this trend; the aim was to make the audience

¹² See Saint-Martin (1990: 208) for the reading of pictures and the network of links between spatially separated visual fields.

¹³ In *YOUNG AND INNOCENT* (Hitchcock 1937) the camera focuses in a fast move from the highest position, next to the ceiling to a close-up of the drummer and his eye. The twitch of his eye unveils his identity (as murderer) to the audience. The protagonists have to find another way (helped by chance) to identify the murderer (cf. Truffaut 1968: 93).

¹⁴ A classical precursor is the discussion in the 18th century in European Enlightenment about the relation between beauty and truth. Untrue stories or pictures cannot be beautiful. The truthfulness of communication is even a problem in animal communication; cf. Honavar/Ma (2015).

forget that it is watching a film and to eliminate all elements which show that the film is an artifact produced via a camera and a projector.¹⁵

The central question of realism in films concerns motion and interaction in space. One can ask: Is the scene physically possible given the laws of gravitation, free fall, locomotion, and possible effects of forces (jumps, blows, pistols, and moving projectiles)?¹⁶ In thrillers, the tendency is to approach the limits of probability in order to demonstrate the excellence of the hero and to a lesser extent that of his enemies.¹⁷ In many instances one can doubt the physical realism of the scenes. In the film *GOLDFINGER* (Hamilton 1964), Bond's adversary is sucked out of the plane after his bullet has destroyed a window, which can be shown to be physically impossible. In the film *CASINO ROYALE* (Campbell 2006), Bond makes a Bungee jump from the height of a barrage. Tolan/Stolze (2008) show that the duration of 13 seconds is unrealistic given the distance of 100 m, the acceleration of a falling body (Bond), the elasticity of the bungee rope etc. The filmmakers had to use a slow motion picture and to repeat elements of the jump from different angles in order to arrive at 13 seconds from a realistic value of 4.5 seconds. Many scenes are, however, at the limit of realism: Thus in the film *MOONRAKER* (Gilbert 1979), Bond is thrown out of a plane by Jaws and tries to reach the pilot, who sprang three seconds earlier, and is going down on a parachute. Jaws, who springs 33 seconds after the pilot, is able to reach Bond, who is now hanging on his parachute after he has successfully fought the pilot. Tolan/Stolze (2008) calculate that the plane must have been at least 6000 meters above earth. Under this condition, both events could, at the limit, be possible (the plane was probably at 3000m from the ground). In *CASINO ROYALE*, the chase between Bond and Molakka is also at the limit of credibility because some of the jumps are so deep that the forces which need to be absorbed by the body at the landing are extreme. Tolan/Stolze, (2008: 30) calculate a force of 16400 Joule, i.e. 1.6 tons (the stuntmen jump into a package of cardboard boxes). In *CASINO ROYALE*, Bond runs after his adversary during a long series of

¹⁵ Actually many theatre directors avoid realistic outfits on stage or in costumes of actors, and thus a parallelism to movies. Instead of "disguised representation" (cf. Dromm, 2008: 194-195), filmmakers can call the attention of the public to the status of film as representation. This is the case in the film *DOGVILLE* (2003). Probably all artwork moves on a scale between perceived (imagined, dreamed) reality and controlled illusion if not fake. See Orson Welles' comments in his film: *F FOR FAKE*, his last major film released in 1974.

¹⁶ In cartoons the restrictions concerning realism seem to be less strict. Nevertheless, Bukatman (2014) tells us in reference to the cartoons of Tom and Jerry produced by Goldwyn-Mayer between 1940 and 1957: "But Hollywood cartoons do not give us an entirely disordered universe of chaos and entropy. They give us a world that is ordered differently: hence *cartoon physics*." (Bukatman 2014: 301-302).

¹⁷ In 2002, a documentary film called *BEST EVER BOND* showed a selection of the ten "bests" scenes in forty years of Bond films; cf. for the list of films: http://programm.ard.de/TV/daserste/best-ever-bond/eid_281066292338027?list=now [last accessed: 10 November 2015]. Many of them are action and fight scenes.

shots. If we consider their speed, we can guess that they would be exhausted after ten seconds. In a similar vein, horse chases in typical Western movies would exhaust the horses after one mile. The question is, however: Is *physical* realism relevant for the audience? Realism, in the eyes of the viewer, is *phenomenological* in its nature, i.e. he/she can imagine the action (if he/she has performed similar actions him/herself) and experience the force he/she has to use to accomplish the action or to absorb the energy of a jump of a certain depth. Judging by this he/she can use extreme experiences such as witnessing a fabulous world record in running or jumping. In his/her judgment, he/she uses a kind of tolerance space, i.e. values in the neighborhood of what is known to be possible are realistic. This version of *tolerance realism* based on phenomenological experience will be assumed in the following analyses. We may distinguish different levels:

1. Realism in terms of *perception*. The iconicity of a photo or a film shot is adjusted to human perception and its automatisms.
2. *Process-realism*. When understanding the image or the movie-shot context-dependent disambiguation is unconsciously provided.
3. *Content realism*. A selection (not the totality) of realistic scenes is chosen. The selection and reframing add a momentum of construal to it (this is typical of documentaries or reports based on documentary materials).

Physical realism is the baseline; the three levels mentioned above and tolerance spaces on each level define a proper space of realism in image and movie.

3 Basic types of kinematics in movies

In reality and correspondingly in films (specifically in action movies), one can distinguish different positions on a scale going from states/rigid positions to very quick and complicated motions. Physical analogues of the dynamics in movies (*movie physics*) are:

- a) The inertia of a body in space without external forces acting on it. Examples are a steady state or a totally damped oscillation. The pendulum in a viscous liquid is the physical prototype. Galileo's inclined plane or the free fall corresponds to motion with a constant acceleration. Thus, in the case of jumps and scenes where objects or persons roll and glide down a slope they make use of these dynamics: cf. the famous ski chases in the James Bonds films *ON HER MAJESTY'S SECRET SERVICE* (Hunt 1969) and *THE SPY WHO LOVED ME* (Gilbert 1977) and the plane gliding downhill on snow in *SPECTRE* (Mendes 2015).

b) A steady motion can be combined with forces acting on it. The physical prototype is the elliptical motion of the planets attracted by the sun (see Kepler's laws). Along with natural forces the human will can be a force which directs motion, locomotion and action. If two humans interact, the force field may be coordinated or antagonistic, symmetrical or complementary (cf. Watzlawick's fifth axiom of communication in Watzlawick et al, 1967).

c) With three moving bodies depending on each other, chaotic modes occur. If the bodies are very different in size, the system is relatively stable (e.g. the system of several planets moving around the sun). Human action may be confronted with chaotic dynamics, in case more than two human wills with similar force profiles interact or apply to the same object/process (cf. triangular social relations or *ménage à trois*).

In the following I shall discuss correlates of these motion patterns in *movie physics*.

3.1 Steady motion and lack of motion or rigidity

This position is found in classical art, in photography, and limitedly in films (mostly in short passages at the beginning or the end of a story):

- The movement of a river, the passers-by, the traffic or the wind and the waves. This is the eternal movement of the type of "Panta Rhei" in Heraclitus. A character walking in the street, a car rolling on a road is experienced as (almost) forceless. Biro (2008) distinguishes "turbulence" and "flow" in movies. "Flow" corresponds to steady motion.
- The classic landscape or architecture picture in Fine Arts has a parallel in descriptive scenes of the film, when the camera either shows a landscape slightly in motion by wind in the branches, a town, an interior or if it moves steadily on a car, a train etc.
- The static portrait has a filmic counterpart in close-ups of the face, which often have a characteristic rigidity. This can refer to hidden emotional (in a romance) or cognitive processes (in a thriller).

In the closing scene of *QUEEN CHRISTINA* (Mamoulian 1933) where Christine (Greta Garbo) leaves Sweden and her throne on a ship, the immobility of her body and face are characteristic. The mechanical counterpart of this dynamic/static type is the damped pendulum, which makes the system remain close to resting point (see Figure 4).

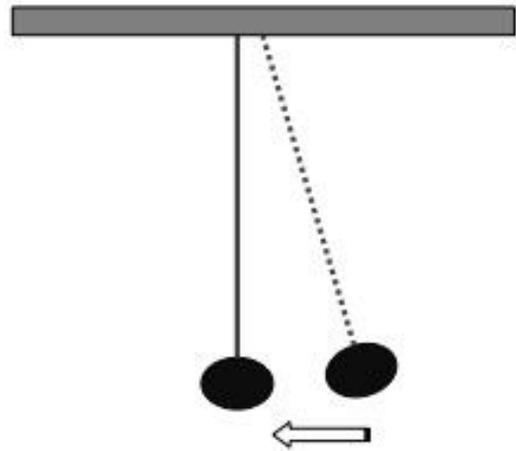


Figure 2.4: Quasi still in the final scene of *QUEEN CHRISTINA* with Greta Garbo and pendulum with rest position

3.2 Motion controlled by a force.

In a pendulum, the original motion pushing it refers to a specific force in the system (e.g. a clockwork) or its context; the rest position is a minimum position, i.e. either the forces disappear or contrary forces nullify each other. In a planetary system, gravitation is the basic force which transforms the normal linear motion of the planet into a stable orbit if the distance is adequate. In the context of locomotion and action beyond physical and muscular forces a kind of will is assumed as controlling force. Major types of controlled motion are:

- The targeted locomotion. It has two limitations: start and finish. Often the target dominates; e.g. the extreme West in the Western film (*frontier motive: the settlers try to reach the far West*) or marriage in a love movie.
- Spatially structured movements. The space has boundaries and transitions. Consecutive episodes repeat similar actions (e.g. chases) in different spatial contexts. Normally the series ends with a final scenario: death of the antagonist, union of the lovers. The different spaces may be linked to different shots or appear simultaneously on the screen. Burch (1983) enumerates six boundaries of the “movie cube”: *onscreen*: left side (1) – right side (2) – above (3) – below (4) –in front (5) – behind (6) and *offscreen*. Spatial transitions are therefore either represented by camera angle or motion, montage or onscreen transitions.

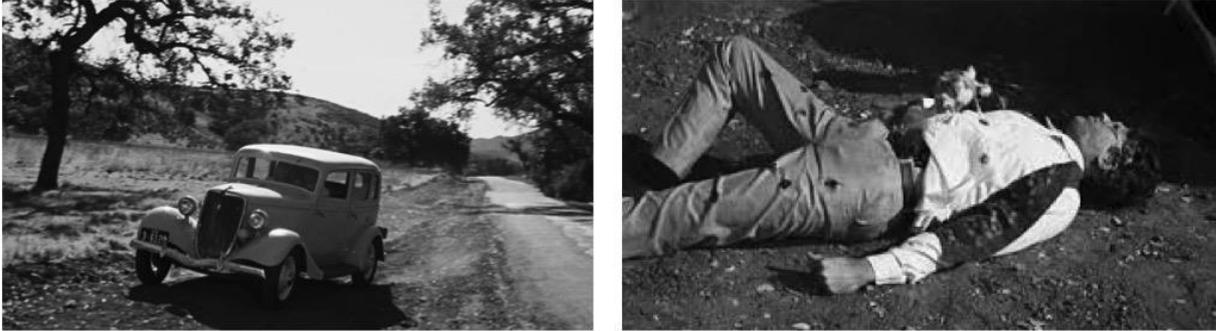


Figure 2.5: Screenshots from the final scene in BONNIE AND CLYDE (Penn 1967), after many episodes of crime

An example of a targeted and force-controlled locomotion is given in Figure 5: The showdown of BONNIE AND CLYDE (Penn, 1967) repeats the basic scenario. Characteristic phases are: driving (by car) → stop → confrontation → death. In the final scene, the protagonists (the gangsters) are killed and not their adversaries.

3.3 A plurality of movements affecting each other

- Simple physical analogues are cascaded pendulums which transmit the initial momentum from the first to the last one in a chain.
- More complicated motion patterns are shown in coupled pendulums. These can have stable modes, such as the movement of bipeds, quadrupeds and insects; the limbs are the pendulums; in general they move in pairs or triples, thus simplifying the dynamics to two main forces (see Haken 1996: chap. 9, Animal gaits and their transitions).
- Chaotic modes occur with double or multiple pendulums; the motion of the second pendulum depends on the motion of the first one.

Coupled dynamics occur in films in which a series of processes is shown or where a plurality of forces interacts. This feature is central in many action films. Some examples may illustrate the three types of dynamics:

- Domino effects: one event triggers the next. Thus, a series of murders occurs in the crime film, either the murderer continues the given type (the case of Jack the Ripper) or in order to escape or hide his first murder he/she commits further ones. Repeated scenes of attack and flight are shown in war movies; the classical example is Eisenstein's "Massacre on the stairs in Odessa" in BATTLESHIP POTEMKIN (Eisenstein 1925).

- Chase and escape sequences in many action films and Western films (see the examples below). The underlying momentum of the persecution is: A pursues B (in space with obstacles).
- Parallel sequences of events that are linked selectively. The events are originally independent but come into contact/interaction by chance. I will discuss this feature in the context of Bond movies later.

3.4 The moving camera

Another important feature concerns the focus and movement of the camera: change of shot, zoom or a moving camera on a camera sled, vehicle or crane. It follows the movement of the actors and simulates the motion of an imaginary viewer. Since the 1950s, hand-held cameras are used to simulate the natural movement of the viewer's attention (the 'subjective view'; early forms are the 'keyhole effect' or mask images). The steadicam perfected the technique of hand-held cameras in the 1970s. It can be carried by a person who follows the actors or precedes them (cf. Schemikau 2006). Examples of intensive camera movement are *BREATHLESS* (Godard 1960; see Figure 6), *ROCKY* (Avildsen 1976), *THE MARATHON MAN* (Schlesinger 1976; see Figure 6).



Figure 2.6: Belmondo in *BREATHLESS* (1960) and Dustin Hoffman in *THE MARATHON MAN* (1976) (screenshots). The camera moves in front of the actors in the street.

4 The (re-)construction of a story in movies

The focus of the camera and the construction of the sequence of scenes in the editing room constitute the central levels of organisation of cinematic meanings. They supplement and complete the work of the actors in their performance in front of the camera. This is a major difference from the theatre where, although spatial positions, movements, and perspectives may be prepared, the result cannot be designed as detailed and radically as in the subsequent

construction by montage. We can thus distinguish three sub-levels of meaning-construction in the film:

1. The construction of meaning *in the set*, in front of the camera (prepared by the script, planned by stage management, and made concrete by the actors).
2. The construction of meaning by *camera work* due to the choice of setting, control of lighting effects, and by the movement of the camera in space and zooming. In most cases, a multiple of the required film material is recorded, i.e., the camera creates a potential narrative space from which radical selection starts. Complementary to the captured pictures, the *off* or *hors-champ* is used, which can contribute connotative meaning.
3. *Montage*. In its first stage, it is primarily privative, i.e. large parts of the film material are discarded. The film director in the editing room resembles the sculptor who shapes the figure, existing only in his/her imagination, from the marble block. The syntactic and narrative order, which is generated by montage, is basic and elaborates the rough design of the plot on the storyboard. In contemporary films, some scenes are computationally produced or supplemented by special effects. In some cases, even major parts of the film may be electronically produced and augmented by scenes technically made with the use of a camera (movements of real actors may be used for the animation of artificial characters that were formed on the computer).¹⁸

These three levels of meaning are essentially *visual*. *Textual-linguistic* and *musical-acoustic* dimensions are added. Different versions of a film may even use dialogues in other languages or be shown without music, which can be performed live by an orchestra. This demonstrates the relative independence of the three basic constituents: *Image - Text - Music*. The level of visual organisation is structured as shown above: organisation in front of the camera (director and actor) – camera and lighting performance – cutting, montage, and special effects. The film must integrate these three levels and avoid redundancy and contradiction. The integration is done in specific zones of each organisational level, so that, in general, these remain relatively autonomous. Thus, the montage and organisation of texts must match. Every change in the montage automatically changes the text structure and narrative content. Moreover, the focus of the camera must respect the weight of every person or harmonise their roles in the text. If the main person is in no way highlighted (optically via its size or its motion when the

¹⁸ In Steven Spielberg's film „THE ADVENTURES OF TINTIN. THE SECRET OF THE UNICORN” (Spielberg 2011) the Performance-Capture-Technology is used to create a “skeleton” of the moving actor, which is then covered with the shape of the comic figures, e.g. Tintin, the captain Haddock etc. Moreover this technique allows an artificial acceleration of movements and thus some effects difficult to achieve with real actors (cf. Schickel, 2012: 250-255).

camera follows it), specific narrative threads are not appropriately represented. The integration of music has to be coordinated with the editing and montage, but it is also tied to the narrative structure to the extent that passages of complications and the climax phase of the story should also correlate with the music. The dominant dimension is certainly the visual construction that is performed by the actors, the camera, and by cutting and montage. Overall, a sufficiently large space for expression must be provided, without which the filmic semiosis would fail for reasons of complexity. The separation of the levels of organisation and their degree of autonomy is the key to the necessary reduction of complexity. In this regard, the silent movie has been an historical experiment as it has shown the degree of autonomy of the visual aspect of film (and its limits; see, for example, the analysis of Lang's silent movie *DIE NIEBELUNGEN: SIEGFRIED* (1924) in Wildgen 2013b). The techniques for the mastery of complexity are roughly the same as in language. First, a standardised lexicon of pictorial and montage techniques is developed. Secondly, rules are provided for the syntactical organisation on several levels. In this regard, we may speak of a language (grammar) of film.

In the following section, I will analyse some aspects of the last Bond films (2006-2015), mainly the second film, *A QUANTUM OF SOLACE* (Forster 2008), in relation to action sequences, parallel actions, and acceleration or deceleration (see for more details Wildgen 2013a (in German) and 2014 (in English)).

5 Movie physics in action movies (with a focus on Bond movies)

The basic dynamics of Bond movies are already present in Hitchcock's classic thrillers with one central male protagonist who has to fight a whole bulk of adversaries (among them also policemen or police authorities). This is clearly the case in three Hitchcock films:

1. In *THE 39 STEPS* (Hitchcock 1935), the hero Richard Hanney must escape the police, which think he is the murderer, and an organization of spies at the same time. In this enterprise, several young and pretty women trust and help him.
2. In *THE FOREIGN CORRESPONDENT* (1940), we witness again an amateur who is drawn into complicated and dangerous adventures.
3. In *NORTH BY NORTHWEST* (1959), a similar paradigm is used: The protagonist cannot imagine why he is followed and risks to be killed. Central scenes of persecution and flight occur when he is waiting in a very open and lonely place and is suddenly attacked by a plane such that he has to hide in a cornfield.

The recurring motive amounts to a protagonist who struggles with a large number of better equipped and organised adversaries (policemen and criminal gangs), although he is not involved in the underlying conflict or intrigue. In the case of the Bond films, the situation is much simpler: it is the job of the man with the license to kill to accept all the chases, struggles, and fights which occur.

Furthermore, well known places are characteristic for these films. They are usually distributed over several continents, but England remains the central point of Bond's 'empire'. This feature is particularly highlighted in *SKYFALL* (Mendes 2012), which commemorates the 50th anniversary of the series. Transitory locations also play an important role, e.g. the lobbies of hotels, elevators, railway stations, airports, and crowded places, such as the market square of Siena where the finish of the traditional horse race takes place (in *A QUANTUM OF SOLACE*; Forster 2008) and the Turkish bazaar in Istanbul (*SKYFALL*). Bond is constantly in transition and he gets acclimated to every place he is in as if it were home. The decor of the rooms has changed over the years. In *A QUANTUM OF SOLACE*, recognized and attractive places, such as Lake Garda, Siena, London, Port au Prince, and the Bolivian highland, are preferred. In *SKYFALL*, even the pursuit over the rooftops of Siena in the previous film is quoted in the opening scene when Bond is chasing his opponent over the rooftops of the bazaar in Istanbul (now on motorbikes instead of by foot). Such resumptions are characteristic of the movie series. The climax of action (with the consolation scene announced in the title of the film) in *A QUANTUM OF SOLACE* occurs in the Desert Hotel *Perla de las Dunas* (Bolivia). The successive explosion of parts of the building (right to left) is committed to a new technology with hydrogen fuel cells. Thus, the central themes, *water - water resources and water scarcity - hydrogen*, come to head.¹⁹ In *SKYFALL*, the final confrontation occurs in a Scottish castle, the site of Bond's childhood. Again, this place is completely destroyed. Besides the action-scenes, destructions and explosions are a basic dynamic schema of Bond films.²⁰

5.1 Pursuit and acceleration in Bond films

As Kracauer remarks in his classical analysis, chases, pursuits of antagonists are the most characteristic feature of the film medium (cf. Kracauer 1964: 72) and they were already central in early films around 1900 in France (*LA COURSE DES SERGEANTS DE VILLE* 1906) and characteristic for the climax in the movies of Griffith (cf. Kracauer 1964). They contribute to

¹⁹ In reality the building was an astronomic observatory in Peru. The destruction was filmed using a model in the production hall.

²⁰ In Christian (Greek and Jewish) myths of the final destruction of the world and the ultimate judgement (apocalypse), this is a major feature. It reappears as a central motif in many action films.

the “dynamisation of space”, as Erwin Panofsky tells us (cf. Kappelhoff 2008: 24). Steven Spielberg, who later became a master of blockbuster films, produced his first thriller, *THE DUEL* (1971 on TV, 1973 in cinema), which is practically *one* chase and flight on the road between a car driver and a truck driver. The motive of manhunt or tracking is central for Western films and thrillers in general. It realises the archaic schema of chase and flight and demonstrates the motor control of the protagonists.

In the following, I will investigate the film *A QUANTUM OF SOLACE* in respect to the structure and complexity of selected chase scenes. Similar structures can be detected in all Bond films and in the genres ‘action movie’ and ‘thriller’. I shall first describe some dynamic schemata underlying simple event and action structures (see Wildgen 1994: chap. 3 for a list of process scenarios).

If we take the action and pursuit scenes in the Bond movies, we notice that in the persecution the agent first walks through the streets of a city. As in a dialogue, the persecutor (or the shadowing detective) and the persecuted are shown alternatively. The perspective and the actors change regularly at a certain rhythm. By regular repetition of the change, continuity is suggested. The time gaps in the parallel montage (crosscutting) must be filled in by the viewer. The rhythm of switching between cuts that show the persecuted and the persecutor is a basic speed which can be accelerated or slowed down. The persecutor begins to walk faster and eventually runs and the mode of locomotion can be changed with the use of a faster means of transportation such as by walking > use of a bike > by car > or by helicopter. Characteristically, the means of transportation of the person persecuted change in correspondence: The persecuted flees on a motorcycle, the tracker uses a car, the persecuted changes also to a car, the persecutors use a helicopter, etc. In Western movies, the different agents (or groups of agents) may be on horse, or one party moves in a stagecoach or in a train. This results in endless combinations whose base is always the relative speed of the agents and the way they react to obstacles on their way. In the Bond film, daredevil races are shown where the hero often fights against several and sometimes better equipped opponents and, eventually, make use of some carefully prepared secret weapon (introduced in the first part of the film).

In addition to movement and rhythm of the pursuers and the pursued, a third force can be introduced: the environment in which the fight takes place. It begins to move and change. How do the agents react to collapsing buildings, exploding rooms or the spreading fire? Containers with hot or corrosive liquids begin to leak (due to shooting of the agents) and eventually explode, etc.

This type of propagation of the moving components generates a specific form of perceived acceleration. Of course, this progression must find an end result. Thus, the pursuer may lose track of the pursued, the persecuted becomes a victim of the collapsing rooms or he finally succumbs in direct confrontation with the protagonist. In the classical Western movie, action almost comes to a standstill before the climax (the duel of the rivals). The tension is finally resolved by the final shootout. In *A QUANTUM OF SOLACE*, the viewer is granted just short breaks. Only at the end, when everything is decided, the film is decelerated.

Action movies often have a standard target: the protagonist, who stands for positive values, wins after endless disputes. In the Bond movie, this game is not satirically or ironically reflected (as in some late Western films), but is taken less seriously (it is just for the fun of the audience, which is not really frightened).

5.2 The dynamics of more complex chases in Bond movies

A QUANTUM OF SOLACE already shows a car chase after the opening credits: Cars hunting each other along the Lake Garda and the quarries of Carrara in Italy. The persecutor must first reduce the advance of the persecuted until the latter comes into view or in the firing range (this phase is skipped in the opening episode of the film, it may be represented with great detail in a Western film). This leads to the proper action phase. Just a shootout does not yet decide the chase (it comes along with making it riskier). The cars eventually come into contact, repel, push one another to side, cut their way, etc. It may even come to eye contact between the drivers (if they drive in parallel). In *A QUANTUM OF SOLACE*, Bond shoots into the car beside him, i.e. he has eye contact with the driver. Characteristically, a third party comes into play: the traffic in the opposite direction (often trucks, tank cars or construction trailers, i.e. large, heavy obstacles) or the police who tries to intervene (usually in vain). Indirectly, the road can turn out as a kind of antagonist: Tight curves and dangerous knolls, steep roadsides or dark tunnels, roadwork and traffic congestions must be taken into account by the drivers (see the screenshots in Figure 6). The basic scenario is one of catching and eliminating. This is graphically abstracted in the schema in Figure 6 related to the archetype of capture in catastrophe theory (cf. Wildgen 1982: 42-43).

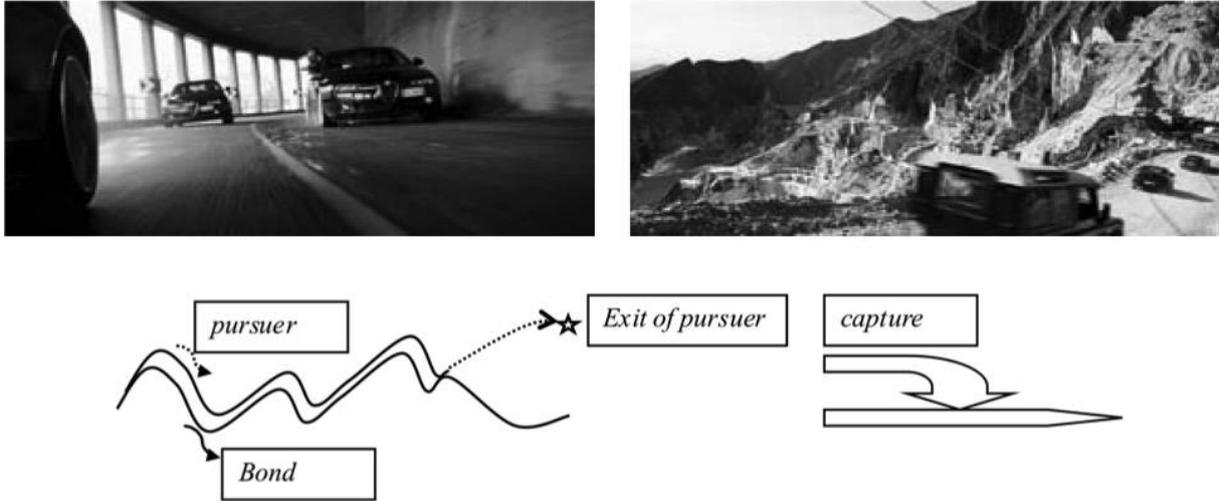


Figure 5.1: Screenshots from A QUANTUM OF SOLACE: Places of chase are a road tunnel at the Lake of Garda and the marble quarries of Carrara (upper part); a schematic description of the chase and the archetype of capture (cf. Wildgen 1982)

The first scene of the film escalates the chase theme. It takes place on two levels: On the first level, Siena is the place where traditional horse races are held in the city centre. These take place simultaneously with the meeting of Bond. On the second level, the prisoner can escape and Bond pursues him across the rooftops of Siena. Bond's hunt goes above the rooftop, finally through a flat and to a bell tower. From the bell tower, both opponents fall onto an unstable scaffold with a rotating freight elevator and the elevator cables are used for a fight in the 'circus dome'. At this point, the linear model is left and the pendulum-like movements take place in three-dimensional space, i.e. not along a path on a surface. The singularities, i.e. the points of local contact and conflict of both actors, are complex in a geometrical sense and difficult to control. In addition, both lose their weapons which are swept away by the movement of the scaffold and the ropes. Both must get hold of their weapons for the final shoot out.

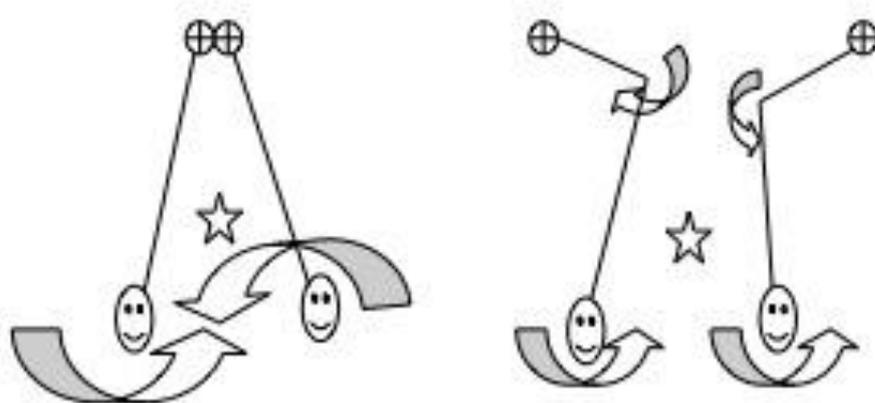


Figure 5.2: Coupled pendulums (the two ropes) and double pendulums (the arm on which hangs the rope also moves)

A kinematic complication is added to the spatial one. The movement of Bond is dependent on the oscillation of the rope and the rotation of the boom to which the rope is attached. Bond, at the last moment, catches his weapon and shoots the opponent, who has also found his gun. The extended model can be described as a coupled pendulum (if both agents oscillating with the ropes touch each other) or as a double pendulum (if the boom, on which hangs the rope, moves). From physics (and chaos theory), we know that the double pendulum has chaotic phases, i.e. its motions cannot be strictly controlled. Coupled pendulums may have harmonic motion modes, but these are accessible only under special conditions. The viewer is obviously not a chaos theorist, but he can understand the increasing uncontrollability (almost physically) and thus estimate the extreme skill of the protagonist Bond.²¹ At the same time, this design points to a fundamental human need that shows up in gambling. The players live in the illusion that they can control a complex situation, which, in fact, they can't. Sutton-Smith (2007: 173) speaks of an illusory "ego-mastery". He interprets this behaviour as an expectation of divine help (Sutton-Smith 2007: 157; the reference to Homer's *Odyssey* is obvious).

The run up of the chase scenes is followed by a short resting phase with the emptying square in Siena, where onlookers are leaving the scene. This is also a repeating pattern. Thus, after a chase by boat (a classic motif in Bond films), Bond runs the boat into a sunny harbour where tourists are embarking. He hands over the unconscious Camille to one of the tourists. After the climax, the story usually ends with a coda, in which Bond and the Bond girl are peacefully united. For example, in the end of the first James Bond film *DR NO* (Young 1962), Bond hugs

²¹ In fairgrounds, complicated multiply rotating carousels are special attractions. In this sense, the action film imitates fairground attractions.

the Bond girl while sitting in the jollyboat (see Figure 8). In *A QUANTUM OF SOLACE*, the fight scenes in the hotel end with a kind of reconciliation of the surviving protagonists, Bond and Camille. But their journey will separate later. In the Jubilee film of 2012, *SKYFALL*, Bond keeps his dying boss M in his arms at the end of the big fight. In *SPECTRE* (UK/USA 2015), the classical happy end is readopted. Bond leaves London with the Bond girl in his refurbished Aston Martin.

5.3 Parallel actions and points of contact/coordination

The pattern of only selectively connected but parallel action sequences, which was characteristic of the episode in Siena, is repeated in Bregenz (Austria). While the opera *Tosca* – incidentally an early melodrama of secret service – approaches its point of culmination, the murder with a knife, Bond disturbs the secret meeting of Greene and his partners. The pursuit goes through the foyer and the kitchen and ends in a duel with another agent. A dramatic chase in Bolivia has the following constellation: An old aircraft (with Bond at the control column) and two pursuit planes. Bond and Camille finally save their lives by parachute, whereas the interceptor planes crash on a mountain. Overall, even if these actions take place at different locations, the narrative is held together by these boiling hunts, which are the dramatic core of the ritualised story.

The last and decisive fight scene brings a new combination into play: Camille wants to kill the murderer of her family, a Bolivian general, who is currently in the hotel Las Dunas, acclimatised by hydrogen fuel cells. Bond wants to get hold of Greene, who negotiates with the general. Both fights are simultaneously taking place after Greene has left his meeting with the general. At the first shooting by Bond, the fuel cells are beginning to explode.²² Thus, three processes run in parallel as the explosion of the hotel is a third force, not controlled by either party. The film presents the two fights in alternating shots: Camille – General and Bond – Greene (see Figure 9, second row). They are coupled when Bond hears a shot. Greene says: “You have again lost someone”. In the following scene, Bond leaves Greene to find Camille.

²² The burning Hotel Perla de las Dunas corresponds to the collapsing scaffolding during the chase scene in Siena.



Figure 5.3 Screenshots from *A QUANTUM OF SOLACE*. First row: Fight in the theatre foyer (exchange of gunfire in the movie); fight on stage in Bregenz (in the opera ‘Tosca’). Tosca stabs Scarpia, the blackmailer. Second row: Parallel fighting in the exploding hotel: Bond against Greene – Camille against the general.

5.4 Probability estimation and the dynamics of suspense

A central feature of action and crime films concern suspense. They share this feature with novels, i.e. suspense is not just a visual effect. It rather concerns the information dynamics inherent in written stories and filmed ones. Wuss (1996: 52) mentions three conditions for tension:

1. the probable occurrence of a relevant (often menacing) event in an undefined course of events,
2. the possibility of the protagonists being able to be active in bringing the events under control by certain forms of conduct (i.e. preventing the negative outcome of events),
3. there is a difference between the information viewers have about the uncertain situation and the kind of information to which the protagonists are privy.

The reader/viewer can guess the probability of different issues or types of denouement. He/she has a natural sympathy with one party, e.g. the innocent hero in Hitchcock’s *NORTH BY NORTHWEST* who tries to escape his hunters. If the persecutors are superior (on a plane or armed, in greater number and anonymous or disguised), the spectator will guess a very low probability of survival/success of the hero. This creates a tension between his wish/sympathy and the most likely outcome. If this situation of tension is iterated, i.e. the hero escapes in spite of very low probabilities again and again; an increasing vector of suspense is created

which must finally be resumed in a climax, in the ideal case with the survival or even victory of the hero. In the case of love stories, emotional risks may accumulate and be finally dissolved. In many films, suspense distracters are introduced, so called MacGuffins, where some of the guess making in the audience is attracted by an element which finally shows up to be irrelevant for the denouement. In films, it is important to keep the level of suspense over long periods (with variations of intensity). It should only drop at the end of the story.

5.5 Mastery of space and the art of dynamic balance

Since acceleration quickly reaches its limits, the action film must connect phases of acceleration and deceleration.²³ This results in a basic rhythm of fast versus slow, to which the narrative must be adjusted and which also controls background music. Phases of partial completion (sub-gestalts) divide the film like chapters in a book. Overall, a balance of intensive action / acceleration, deceleration / calmness is searched for. As there are many ways to achieve such a balance, it becomes characteristic for different film genres. The balance of slow versus fast has a counterpart in the balance of affective values (*love* versus *hatred*). The affective dynamics define specific expectation horizons, which in turn generate tension. Rhythms of change distinguish individual film genres and films (see for this topic Eidsvik 2007).

The mass media of film and television use general human perception and understanding skills, but the learning process especially with an audience experienced with films is also relevant. Therefore, one should distinguish between general laws and cultural codes. The latter are historically variable. Many contingent factors are relevant, e.g. political backgrounds, theories, ideologies, individual motivations of the filmmakers or preferences of a specific audience. Different styles are created which appear and disappear almost like cloth fashions or styles in architecture or literature. The Italian 'Neorealismo' (after World War II, Rossellini, de Sica, Visconti, Fellini) and the French 'Nouvelle Vague' (late 1950s and 1960s; Godard, Truffaut, Chabrol) avoided the linearity and smoothness of action in Hollywood films, which Hitchcock had brought to perfection. The filmic narrative rather presents sequences of fragmentary and dismembered encounters (cf. Aab 2014: 180). Instead of a coherent image of actions, a mental image of situations and social relations is created.

²³ From the perspective of the audience, human locomotion (supported by horses or machines) is the standard of comparison. The upper limit of speed in relation to the spectator or the moving camera is given by the human faculty of visual tracking. Speeds beyond this threshold are irrelevant.

6 Conclusion

The analysis has shown that typical signs in cinema are kinematic and dynamic in their nature, i.e. they refer to motion, locomotion, action (chase, flight, fight). If action and conflict are not the central concern, emotional events, dialogues, and changes in the social, political status or of emotional constellations may be the relevant dynamics (emotion instead of motion). A frequent consequence of conflict is the disappearance or death of agents, the breaking of alliances and love connections, and the building or consolidation of new ones. In his novel “Wahlverwandtschaften” (1809; filmic adaptation in ELECTIVE AFFINITIES, Taviani/Taviani 1996), Goethe used chemical metaphors as background of the emotional transformations, i.e. he applied chemical/physical laws in literature and thus prefigured a kind of *literature physics*.

The focus on motion, forces, and the control of motion and stable states gives a new relevance to space and its organisation in one, two or three dimensions. The linguistic bias with its preference for concatenation (one-dimensionality and discreteness) is overthrown and the door for a proper treatment of *non-linguistic* (visual, musical, olfactory, etc.) signs in our real world is opened.

The tools of dynamic systems theory (attractors, vectors, bifurcations, catastrophes, chaos) may be used to further specify the inventory of types which reoccur in many semiotic (and non-semiotic) systems. They can complete (if not replace) the purely relational, if not static, terms of logics which have dominated semiotics in Hjelmslev’s structuralism (and later in the semiotics of Eco and Greimas) and in linguistic schools inspired by Analytic Philosophy (e.g. in the Chomskyan paradigm). The dialogue with natural sciences relevant in this field (physics, chemistry, biology, cognitive sciences) requires new conceptualisations and a proper way of applying mathematics.

Bibliography

Aab, Vanessa (2014): Kinematographische Zeitmontagen : Zur Entwicklungsgeschichte des Kinos (Marburger Schriften zur Medienforschung, 47). Schüren, Marburg.

Anderson, Joseph D. and Barbara Fisher Anderson, (eds) (2007): Narration and Spectatorship in Moving Images. Cambridge Scholars Publishing, Cambridge.

Beckman, Karen (ed.) (2014): Animating Film Theory. Duke University Press, Durham.

Biro, Yvette (2008): *Turbulence and Flow in Film. The Rhythmic Design*. Bloomington: Indiana University Press.

Bukatman, Scott (2014): “Some observations Pertaining to Cartoon Physics; or, The Cartoon Cat in the Machine”; in: Beckman (2014: chapter 17).

Burch, Noël (1983): *Theory of Film Praxis* (French original, *Praxis du cinéma*), Secker, Warburg, London.

Chapman, James (2007): *Licence to Thrill. A Cultural History of the James Bond Films*. I.B. Tauris, London (2. Edition).

Dromm, Keith (2008): “Spielberg and Cinematic Realism”, in: Kowalski, Dean A. (ed.) *Steven Spielberg and Philosophy. We’re Gonna Need a Bigger Book*. The University Press of Kentucky, Lexington: 191-209.

Eidsvik, Charles (2007): “Neurotransmitter Persistence, Narrative Structure, and Emotion: A Realistic View”, in: Anderson and Fisher Anderson (2007: 42-48).

Haberlik, Christina and Andrea C. Busch (2003): *50 Klassiker. Architektur des 20. Jahrhunderts*. Gerstenberg, Hildesheim.

Haken, Hermann (1983): *Synergetics. An Introduction* (third revised and augmented edition). Springer, Berlin.

Haken, Hermann (1996): *Principles of Brain Functioning. A Synergetic Approach to Brain Activity, Behavior and Cognition*. Springer, Berlin.

Honavar, Vasant and Ma; Zhanshan (2015): *Towards Computational Models of Animal Communications, an Introduction for Computer Scientists*, in: *Cognitive Systems Research* 33 (2015) 70–99.

Kappelhoff, Hermann (2008): *Realismus. Das Kino und die Politik des Ästhetischen*, Vorwerk8, Berlin.

Kelso, J.A. Scott (1995): *Dynamic Patterns. The Self-organization of Brain and Behavior* MIT Press, Cambridge (Mass.).

Kracauer, Siegfried (1984): *Theorie des Films. Die Errettung der äußeren Wirklichkeit*, Suhrkamp, Frankfurt/Main (American original, 1960).

Kramer, Mette, 2007. “The Epistemology of Gaze”, in: Anderson et al., 2007: 136-147.

Kühl, Ole (2007): *Musical Semantics*, Lang, Bern.

Liu, Anan and others (2007): “Human Attention Model for Action Movie Analysis”, in: *IEEEExplore. Digital Library*, 1-4244-0971-3/07.

Metz, Christian (1968): *Essais sur la signification au cinéma*. Klincksieck, Paris.

- Petitot, Jean (1992): *Physique du sens. De la théorie des singularités aux structures sémi-narratives*. Éditions du CNRS, Paris.
- Petitot, Jean (2003): *Morphogenesis of Meaning*. Peter Lang, Bern.
- Pranger, Regine (2012): „Zur Theoriegeschichte der filmischen Raumkonstruktion und ihrer Aktualität als Gegenstand einer historischen Bild- und Medienwissenschaft“, in: Idem (ed.), *Film als Raumkunst. Historische Perspektiven und aktuelle Methoden*. Schüren, Marburg: 12-53.
- Saint-Martin, Fernande (1990): *Semiotics of Visual Language*. Indiana: Indiana University Press.
- Schemikau, Mirko (2006): „In Bewegung – der schwebende Blick der Steadycam“, in: Koebner, Thomas und Thomas Meder in Verbindung mit Fabienne Liptay (eds.), *Bildtheorien und Film, edition Text + Kritik* (Boorberg Verlag), München: 316-334.
- Schickel, Richard (2012): *Spielberg. Seine Filme, sein Leben*. von dem Knessebeck, München.
- Souriau, Étienne (1969): *La correspondance des arts*. Flammarion, Paris.
- Sutton-Smith, Brian (2007): “The Ambiguity of Play. Rhetorics of Fate”, in: Bial, Henry (ed.) (2007): *The Performance Study Reader*. Second edition. Routledge, London: 152-158.
- Thom, René (1990): *Semio physics. A Sketch*. Addison-Wesley, Redwood City, Calif. (French original: *Esquisse d’une sémiophysique: physique aristotélicienne et théorie des catastrophes*, Interéditions, Paris, 1988).
- Tolan, Metin and Joachim Stolze (2008): *Geschüttelt und nicht gerührt. James Bond und die Physik*. Piper, München.
- Truffaut, François (1968): *Hitchcock* (French original: *Le cinéma selon Hitchcock*, 1966). Secker & Warburg, London.
- Vorderer, Peter, Hans J. Wulff and Mike Friedrichsen (eds.) (1996): *Suspense. Conceptualizations, Theoretical Analyses, and Empirical Explorations*. Lawrence Erlbaum, Mahwah (NJ).
- Watzlawick, Paul; Jackson, Don D.; Bavelas, Janet Beavin (1967): *Pragmatics of Human Communication. A Study of Interactional Patterns, Pathologies, and Paradoxes*. Norton, New York.
- Weidlich, W. and Haag, G. (1983): *Concepts and Models of a Quantitative Sociology. The Dynamics of Interacting Populations*, Berlin, Springer (Springer Series in Synergetics 14).
- Wildgen, Wolfgang (1982): *Catastrophe Theoretical Semantics. An Elaboration and Application of René Thom’s Theory*. Benjamins, Amsterdam.

- Wildgen, Wolfgang (1986): „Synergetische Modelle in der Soziolinguistik. Zur Dynamik des Sprachwechsels Niederdeutsch-Hochdeutsch in Bremen um die Jahrhundertwende (1880-1920)“, in: Zeitschrift für Sprachwissenschaft, 5 (1): 105-137.
- Wildgen, Wolfgang (1994): Process, Image, and Meaning. A Realistic Model of the Meanings of Sentences and Narrative Texts. Benjamins, Amsterdam.
- Wildgen, Wolfgang (2004): The Evolution of Human Language. Scenarios, Principles, and Cultural Dynamics, Benjamins, Amsterdam.
- Wildgen, Wolfgang (2013a): „Erzählung und Action im James Bond-Film: Ein Quantum Trost“, in: Bateman, John, Matthis Kepser and Markus Kuhn (eds.), Film, Text, Kultur. Beiträge zur Textualität des Films. Schüren, Marburg: 321-345.
- Wildgen, Wolfgang (2013b): Visuelle Semiotik. Die Entfaltung des Sichtbaren. Vom Höhlenbild zur modernen Stadt. Transcript, Bielefeld.
- Wildgen, Wolfgang (2014): “Dynamic Meaning Construction in Action-films (specifically in the last James Bond Trilogy)”, in: RASK: Internationalt Tidsskrift for Sprog og Kommunikation, 40: 423-448.
- Wildgen, Wolfgang (2015): “Catastrophe Theory and Semiophysics: with an Application to ‘Movie physics’”, in: Language and Semiotic Studies, 1(2): 61-88 (Soochow University Press, P. R. China).
- Wildgen, Wolfgang and Per Aage Brandt (eds.) (2010): Semiosis and Catastrophes. René Thom’s Semiotic Heritage. Lang, Bern.
- Wuss, Peter, 1996. „Narrative Tension in Antonioni“, in: Vorderer, Wulff and Friedrichsen (1996): 51-70.

Filmography

- BATTLE SHIP POTEMKIN (USSR 1925, Dir. Sergei Eisenstein, Goskino)
- BONNY AND CLYDE (USA 1967, Dir. Arthur Penn, Warner Brothers)
- BREATHLESS (FRANCE 1960, French title: *À bout de souffle*, Dir. Jean-Luc Godard, UGC)
- CASINO ROYALE (UK/ USA a.o. 2006, Dir. Martin Campbell, Columbia Pictures)
- DIE NIBELUNGEN. SIEGFRIED (Germany 1924, Dir. Fritz Lang, Ufa)
- DR. NO (UK 1962, Dir. Terence Young, Eon Productions)
- DOGVILLE (Denmark a.o. 2003, Dir. Lars von Trier, Lions Gate Entertainment)
- DUEL (USA 1971, dir. Steven Spielberg, Universal Studios)
- F FOR FAKE (FRANCE a.o. 1975, Dir. Orson Wells, Speciality Films)

FOREIGN CORRESPONDENT (USA 1940, Dir. Alfred Hitchcock, United Artists)
GOLDFINGER (UK/ USA 1964, Dir. Guy Hamilton, United Artists)
LA COURSE DES SERGENTS DE VILLE (FRANCE 1907, Dir. Ferdinand Zecca, Pathé Frères)
METROPOLIS (GERMANY 1927, Dir. Fritz Lang, Ufa)
MOONRAKER (UK; 1971, Dir. Lewis Gilbert, United Artists)
NORTH BY NORTHWEST (USA 1959, Dir. Alfred Hitchcock, Paramount Pictures)
ON HER MAJESTY SECRET SERVICE (UK 1964, Dir. Peter R. Hunt, United Artists)
QUEEN CHRISTINA (USA 1933, Dir. Ruben Mamoulian, Metro-Goldwyn-Mayer)
ROPE (USA 1948, Dir. Alfred Hitchcock, Transatlantic Pictures)
QUANTUM OF SOLACE (UK, USA a.o., 2008, Dir. Marc Forster, Metro-Goldwyn-Mayer (UK)
/ Columbia Pictures (US))
ROCKY (USA 1976, Dir. John G. Avildsen, United Artists)
SPECTRE (UK / USA 2015, Dir. SAM MENDES, Metro-Goldwyn-Mayer Pictures/ Columbia
Pictures)
SKYFALL (UK / USA 2012, Dir. Sam Mendes, Metro-Goldwyn-Mayer / Sony Pictures)
THE 39 STEPS (USA 1935, Dir. Alfred Hitchcock, Gaumont-British Picture Corporation)
THE ADVENTURES OF TINTIN. THE SECRET OF THE UNICORN (USA /NEW ZEALAND 2011, Dir.
Steven Spielberg, Paramount Pictures/ Columbia Pictures)
THE ELECTIVE AFFINITIES (Italy / France 1996, Italian title: Le affinità elettive, Dir. Paolo and
Vittorio Taviani, FilmTre)
THE MARATHON MAN (USA 1976, Dir. John Schlesinger, Paramount Pictures)
THE SEARCHERS (USA 1956, Dir. John Ford, Warner Brothers)
THE SPY WHO LOVED ME (UK; 1977, Dir. Lewis Gilbert, United Artists)
TRUMAN SHOW (USA 1998, Dir. Peter Weir, Paramount Pictures)
VERTIGO (USA 1958, Dir. Alfred Hitchcock, Paramount Pictures)
YOUNG AND INNOCENT (UK 1937, Dir. Alfred Hitchcock, GFD Gaumont Film Company)