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**PRACTICES OF PHYSICAL AND
DIGITAL SPECIAL EFFECTS MAKING:
AN EXPLORATION OF SIMILARITIES
AND DIFFERENCES FROM A
BRICOLAGE PERSPECTIVE**

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BRICOLAGE PERSPECTIVE***

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ABSTRACT

This paper looks at practices of physical and digital special effects making in the context of the growing use of digital technologies in movie making. It develops a theoretical framework based on Lévi-Strauss's notion of *bricolage* and applies this framework to direct and indirect sources in order to develop an understanding of the elements and processes that characterize the making of special effects. After discussing the usefulness of *bricolage* as a perspective for organizational analysis, the paper concludes with the authors' views about the evolution of special effects making practices.

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PRACTICES OF PHYSICAL AND DIGITAL SPECIAL EFFECTS MAKING: AN EXPLORATION OF SIMILARITIES AND DIFFERENCES FROM A BRICOLAGE PERSPECTIVE

This paper looks at local practices in the making of movie special effects. It puts a particular emphasis on the influence of the growing use of digital technologies on practices of physical effects making. In other words: our interest is in a particular set of local practices within the creative industries that we consider being especially exposed to new technologies, and which will serve as a basis for opening discussion about how practices can be understood. From a theoretical point of view, this paper proposes to use Claude Lévi-Strauss's concept of *bricolage* to study effects makers' local practices. We analyze material from interviews and various indirect sources and propose an analysis of the specificities, commonalities and interaction of practices related to physical and digital effects. Our conclusions are situated on two levels: the development and interaction of practices in the movie special effects field, and the use of the concept of *bricolage* in the analysis of local practices.

The paper is structured as follows: The following two sections provide an introduction to the field of movie special effects and develop the concept of "bricolage". The third and fourth section present our empirical work, findings and discussion, and the final section presents our conclusions concerning the development of the field of movie special effects field and the value of *bricolage* as a concept for understanding local practices.

MOVIE SPECIAL EFFECTS

The *Dictionnaire des arts médiatiques* (Groupe de recherche des arts médiatiques, UQAM, 1996) defines a special effect as an (audio-)visual illusion created either on the film set or during post production, by artificial or electronic means. The making of movie special effects is an act of constrained creativity. It demands, on one hand a highly creative act in which the implicated actors have to find often novel solutions to problems posed by specific location, the movie script or the movie director's ideas about how a final scene should look like, and it is, on the other hand, embedded in a highly complex pattern of interaction and interdependence among different actors at any given point in time (e.g. the reciprocal interdependence between director, actors, cameramen, decorators, etc.) as well as over time (e.g. the sequential interdependence of production and post-production).

Practices of making movie special effects are highly exposed to new technologies, notably digital technologies including computer graphics and computer animation with their possibilities to simulate effects or scenes in a virtual space. From a theoretical point of view, digital technology not only adds organizational complexity to special effects making but has an impact on how movie effects making practices evolve.

Today, special effects can be developed either on the set through the physical set-up of an arrangement that creates an illusion during the shooting, or during post-production through an incrustation of virtual elements into the original film material. For this paper, we define a *physical effect* as the creation of an illusion through an assemblage of material objects on the movie set, while *digital effects* are based on virtual images added in post-production to complement or alter the initial image. We do not consider in this paper the case that an entire movie is produced in virtual space. The starting point for the research related in this paper was our interest in the development of local practices of making physical movie special effects under the influence of digital technologies. The principal focus of this paper is therefore on physical effects.

BRICOLAGE

Bricolage, a notion initially introduced by Claude Lévi-Strauss (1966) has more recently gained popularity across a wide range of domains related to organizations and organizing. Prominent examples can be found in organizational symbolism (e.g. Linstead & Grafton-Small, 1990), knowledge and learning (e.g., Miner et al., 2001), improvisation and creativity (e.g., Weick, 1998), entrepreneurship and innovation (e.g., Baker et al., 2003; Garud & Karnoe, 2001), as well as in the design and appropriation of information systems (e.g., Ciborra, 1992). It has been used to account for the diversity of local practices and to explore the local nature knowing as well as for emphasizing the reciprocal relationship of human actors and their close material environment. Some refer to it as the capability to "do things with whatever is at hand" while others relate it to path dependency and lock-in of actors into a closed repertoire of objects, meanings, and interpretations.

To develop the specific understanding of the notion of *bricolage* made in this paper we first review some of the uses made of *bricolage* in organization and management theory, then reconsider Claude Lévi-Strauss's (1966) initial formulation of the concept, and finally propose a complement for the study of local practices in an *organizational* setting.

***Bricolage* in organization and management theory**

The term *bricolage* is introduced in the organization and management literature in the late 1980s to describe two types of phenomena. With respect to the development of information systems, Ciborra (1992, 1994, 1996a, 1996b) uses the term *bricolage* in order to characterize a particular strategy of information technology appropriation in which a information system is seen by a user as a set of means he or she can (re-)assemble at any given moment according to actual informational needs. Despite their technological rigidity, information systems are characterized by a high degree of flexibility in use which allows users to act as *bricoleurs*.

For other authors the notion of *bricolage* can be extended towards organizational structure and relates to improvisation (e.g. Orlikowsky, 1996). From this point of view, organizations can be understood as improvising systems characterized by a "mixture of the precomposed and the spontaneous, just as organizational action mixes together some proportion of [...] exploitation with exploration, routine with nonroutine, automatic with controlled" (Weick, 1998: 551), and organizational actors appear as *bricoleurs* that use whatever resources and repertoires they have at hand.

In both traditions, *bricolage* redefines our understanding of productive practices by emphasizing contingencies, innovation and the flexible, situated appropriation of technology, and it provides a vocabulary to address the relation of ordinary action and local knowledge. The notion of *bricolage* itself, however, is not completely free from negative connotations. It can appear as a rapid gesture, grown out of a productivity imperative, aiming at making things "hold" for one moment (Dodier, 1995). It seems more accepted, on the contrary, in distributed organizations in which "all is allowed within the possibilities opened up through proximity negotiations along concrete networks" (Dodier, 1995: 213; translation by the authors).

Virtually all social science contributions on *bricolage* refer to the concept developed by French anthropologist Claude Lévi-Strauss's in his seminal work *La pensée sauvage* (1962) [The savage mind (1966)]. However, many recent contributions show a tendency to over-simplify the richness of Lévi-Strauss's concept by reducing *bricolage* to the fact of combining heterogeneous competencies and means at hand to perform a task that is not planned in advance. Others see *bricolage* where "known tools of the technology are used to solve new problems" (Bar, Kane, & Simard, 2000: 14), or like Lundström and Strömdahl (1998) use the notion of *bricolage* to designate "what we do when conducting experiments and observing the result of our actions" and claim that "to conduct bricolage implies [...] to

apply and combine previously known tools and routines to solve new problems" (1998: 13-14).

Lévi-Strauss's concept of *bricolage*

Claude Lévi-Strauss's (1966) concept of *bricolage* designates as much a particular relation to time, to space, to objects and to knowledge, as a particular way of practical reasoning. In the first chapter of his book, programmatically entitled *La science du concret*, Lévi-Strauss argues that much of the reasoning to be found in indigenous populations is neither pre-logic nor a-scientific but relies on a highly developed mode of knowing based on an intimacy with the concrete. Lévi-Strauss illustrates his understanding of this "science of the concrete" with his idea of *bricolage* as a type of activity that subsists in modern societies:

[...] an activity which on the technical plane gives us quite a good understanding of what a science we prefer to call 'prior' rather than 'primitive', could have been on the plane of speculation. This is what is commonly called 'bricolage' in French. (Lévi-Strauss, 1966: 16)

Lévi-Strauss tries to grasp this mode of acting with a high degree of rigour and precision in a description of the *bricoleur's* specific competencies, his relation to time, to objects and to space, as well as a specific type of associative rationality characterized by the goal of seeing things as "going together" (1966: 9). Despite the precision of his discourse, Lévi-Strauss does not construct a clear definition of *bricolage* but rather tries to seize what he means through frequent changes in perspectives that address the process of *bricolage* as well as the role of the *bricoleur* and draw on comparisons between *bricolage*, myth, play, and art. From our reading, three elements are paramount to understanding *bricolage* according to Lévi-Strauss: his view of the resources used ("repertoire"), the process ("dialogue") and the nature of the result of any process of *bricolage*.

Repertoire

The notion of repertoire is in the center of Lévi-Strauss's concept of *bricolage*. *Bricolage* starts with the constitution of the repertoire and finishes with the return of objects to the repertoire. The repertoire consists of objects that are collected independently of any particular project or utilization on the sole basis of the *bricoleur's* intuition that an object could "be useful one day". For the *bricoleur*, all objects belonging to his repertoire are not only perceived as independent entities but derive their characteristics from their potential for

association, in other words: their capacity of "going together" with other objects from the repertoire:

They [the elements of the repertoire] each represent a set of actual and possible relations; they are 'operators' but they can be used for any operation of the same type. (Lévi-Strauss, 1966: 18)

The *bricoleur's* repertoire comprises elements that are heterogeneous by their material nature, wear and history ("remains of previous constructions or destructions" (1966: 17)), and despite its potentially large size, any *bricoleur's* repertoire is physically limited. The repertoire is held in an equilibrium through a continuous flow of objects, means, ends and significations: It is self-maintaining in the sense that "it is always earlier ends which are called upon to play the part of means: the signified changes into the signifying and vice versa" (1966: 21).

Dialogue

Bricolage as a process, in other words: the activity of assembling objects, starts in the moment in which an objective or practical functions to be served appear. According to Lévi-Strauss the *bricoleur* begins with an inventory of his repertoire and engages in a dialogue with the objects which it contains.

He interrogates all the heterogeneous objects of which his treasury is composed to discover what each of them could 'signify' and so contribute to the definition of a set which has yet to materialize but which will ultimately differ from the instrumental set only in the internal disposition of its parts. (1966: 18).

Lévi-Strauss does not clearly outline the conditions in which this dialogue occurs. However, these can partly be deduced from his description of the "science of the concrete": According to Lévi-Strauss, an actor in a world in which all entities are connected with one another has to have a "preoccupation with exhaustive observation and the systematic cataloguing of relations and connections" (1966: 10), an extremely strong memory (which becomes even more important in a situation of oral tradition), and to respect a form of symmetry and equivalences among the entities that make up his universe.

The dialogue is directed at the capacity of elements contained in the repertoire to be associated within a functionally performing structure and occurs throughout the process of assemblage. Even if the objects in the repertoire undergo certain transformations, the *bricoleur's* principal operation remains the arrangement of objects. If the *bricoleur* realizes that a given object does not "fit" into the structure, he has the "possibility of putting a

different element there instead" (1966: 19). In other words: The assemblage proceeds through permanent testing, permutation and substitution of objects.

Three elements constrain the dialogue. The first is related to the boundaries of the repertoire. The physical limitation of the repertoire forces the *bricoleur* to rely on a limited set of combinations instead of playing with an infinite number of objects. The second boundary is related to the fact that a *bricoleur* (other than the scientist) rarely transcends the class of actions and significations he is accustomed to, and "by inclination or necessity always remains within [the constraints imposed by a particular state of civilization]" (1966: 19). A third constraint that is mentioned only very briefly by Lévi-Strauss is related to the overall time frame the *bricoleur* disposes of in the context of the problem he is addressing. And finally, bricolage is not free but bound to a logic of performance (to repair, to heal, etc.).

Outcome

For Lévi-Strauss, the outcome of bricolage reflects the underlying process: it is an assemblage of different objects that remain visible as such. A second characteristic is its relative distance from the original idea ("inevitably be at a remove from the initial aim [...], a phenomenon which the surrealists have felicitously called 'objective hazard'" (1966: 21)). The outcome differs from the original elements in the repertoire only through the way in which the parts are assembled (1966: 18). This ensures that the outcome of bricolage can be easily be disassembled and re-integrated into the repertoire.

Bricolage and organizations

Lévi-Strauss's ideas about the repertoire, the dialogue and the outcome of *bricolage* focus on the individual *bricoleur*. To use *bricolage* in the context of productive organizations, the concept has to be extended in three directions: collective action, power and constraints, and the outcome as arrangement [*dispositif*] to reflect embeddedness of local practices within organizations. We introduce the collective dimension of *bricolage* by considering the role of objects in different categories of collective action (Livet, 1994; Thévenot, 1990), articulate power and constraints with the notion of "tactics" [*tactique*] used by Michel de Certeau in his analysis of *arts de faire* (1990), and develop the idea of the outcome as arrangement of heterogeneous objects (Berten, 1999).

Collective dimensions of bricolage

For Lévi-Strauss the collective dimension of *bricolage* appears in the transmission of knowledge in the context of a master-apprentice relationship as well as through an individual's immersion in collective rituals. His description of the process of *bricolage*, however, concentrates on the *bricoleur* as an individual, who is the author of his *œuvre*, and who is solitary in his practical gesture -- even if his knowledge derives from the social system which he belongs to.

We propose to complement Lévi-Strauss's initial concept to account for collective action in order to make it applicable to modern productive organizations. Pierre Livet, in his book *La communauté virtuelle - action et communication* (Livet, 1994), proposes a set of ideas for understanding action in its relation of individual physical and cognitive processes and their inscription into a collective space. He distinguishes three basic forms of collective action: *action à plusieurs* ["to act as several individuals"], *action ensemble* ["to act together"], and *action commune* ["to act in common"].

Livet's three modes of action are characterized by the importance and role attributed to the common project, the means used in a collective for dealing with uncertainty and the risk of error, spatial and temporal distances between members, and the nature and place of objects that authorize, condition and stabilize action. These dimensions enable us to relate Livet's categories of collective action to the notion of *bricolage*. For Lévi-Strauss, the place and the structuring nature of the project are fundamental, especially in order to distinguish the *bricoleur* from the engineer and to justify the presence and the nature of the activated means. Uncertainty and the collective dealing with errors can be related to the idea of permanent dialogue between the *bricoleur* and his means and to the infinite possibilities of combination and substitution according to the fitting and the performance of an object within the structure in the making. And finally, the objects of (collective) action play a central role for both Lévi-Strauss and Livet who distinguishes between generic, conventional and personalized objects and argues that each of these categories is characteristic for one of the modes of collective action.

In terms of collective action Lévi-Strauss's notion of *bricolage* is closest to Livet's mode of *action commune* which is characterized by a limited number of individuals who work on a common project within an identical frame of time and space, and who manipulate objects that are highly personalized and transformed throughout their utilization.

Bricolage and power

Lévi-Strauss's *bricoleur* is free from any kind of social constraints. However, his relation with the objects in the repertoire, the constraint to work with "what is on board", causes the bricoleur to employ objects for usages that can be far from those for which these objects had initially been conceived. Whether they are recycled from another use, or drawn away from their initial function in order to fit into the structure in the making, the relationship of the *bricoleur* and his objects is characterized by some form of violence (even though the bricoleur strives in the first place for a way of making things hold together and not necessarily for an alteration or transformation of the elementary objects contained in his repertoire).

The diversion of objects from their initial function has been studied by French philosopher and sociologist Michel de Certeau in *L'invention du quotidien. 1. Arts de faire* (de Certeau, 1990). In his analysis of everyday life, de Certeau develops the idea that consumers, rather than adapting their usages of consumption objects to the ideas of the objects' designers, engage in a form of poaching [*braconnage*]. This happens when an individual moves inside a space that is not his own (i.e. that is not marked by a fixed boundary within which the individual himself determines the rules of action), and in which the individual does not dispose of a stable base to plan and to capitalize on his or her moves. In such a situation an individual's game becomes tactic, which means it plays with time and events in order to create opportunities.

The notions of poaching and tactics enable us to understand the gestures of the *bricoleur* towards his repertoire within a system of constraints and power, as well as to explore the nature of these constraints. Are they external to the repertoire and does the repertoire primarily serve the *bricoleur* for creating a proper space [*espace propre*] to protect him from any disturbing event? Or are the constraints a part of the manipulated objects, which have initially been imported from a world outside the repertoire and thus perpetuate a relationship with their origins? Or do the constraints originate from external performance imperatives the *bricoleur* has to meet ("it has to work")? The issue of diversion not only opens up discussion of these questions and many others, but also allows for an articulation with the notion of objects as we find it in Livet and his ideas of conventionalization or personalization in relation to the generic characteristics of any object.

Bricolage as outcome

We have argued above that Claude Lévi-Strauss is not very specific in his description of *bricolage* as outcome. He describes *bricolage* as a structure that arranges elements coming from the repertoire in a specific way without changing their nature (and thus allowing them to

be reintegrated in their original space). Bricolage refers to an arrangement whose form is not *a priori* intelligible on the basis of the original project. Any form of productive organization, though, needs to punctuate its evolution with points of passage that are recognized as ends, whether they are intermediary in nature or not (and paradoxically even more so the more an organization calls itself "process oriented"). "Deliverables" or "intermediary objectives" translate a willingness to play with stable representations, even if this stability is only temporary. To qualify the outcome of bricolage as this kind of temporarily stable achievement, we propose to characterize it as an "arrangement" [*dispositif*].

From our point of view, the idea of a *dispositif* or arrangement allows very adequately to capture the complexity of bricolage-as-outcome. First of all, it builds on the existence of "another relationship with the material world [...] not on the mode of instrumentalization or alienation, but on the mode of association, of contact or even the affective-physical experience, indeed the mode of play" (Charlier & Peeters, 1999: 17; translated by the authors). The arrangement designates a field composed of heterogeneous elements and allows to deal with this heterogeneity (Charlier & Peeters, 1999). It recognizes the places of the active individual, whose "prodigious inventiveness, the proliferating creativity [...] reveal itself in the setting up of the arrangements" (Berten, 1999: 35; translated by the authors).

Like for Lévi-Strauss who intimately associates the bricoleur and his *œuvre*, the arrangement refers to an association of objects "that touches upon the constitution of identity, that establishes an affective and bodily mediation between me and the world, between me and the other, and eventually between me and me" (Berten, 1999: 38-39; translated by the authors). Any arrangement is ambivalent: it acts simultaneously as an isolated entity ("I am facing an arrangement") and as a space of displacement and action, in other words: an environment (Berten, 1999: 38). Here we recognize Lévi-Strauss's ambiguity of the transitory outcome of bricolage that is eventually disassembled and reintegrates the *bricoleur's* repertoire. The notion of arrangement, however, puts a stronger emphasis on the determination of boundaries of the object studied, and on the performative character and concrete effectiveness of the outcome of bricolage.

The arrangement acts as an "error tolerant environment" (Belin, 1997: 436, quoted in Bertin, 1999: 42; translated by the authors) based on the dynamic of substituting one object of the repertoire for another one -- close to the central act of bricolage for Lévi-Strauss as well as Livet's (1994) ways of dealing with errors as a means to distinguish forms of collective action (Livet, 1994).

The first part of this paper has presented Lévi-Strauss's concept of *bricolage* as a mode of acting that is based on a particular knowledge about the world and its objects, developing a dynamic of constructing a structure from elements from prior collection forming a repertoire and assembled the ones in relation to the others following rules of association and permutation. We have tried to complement this definition by transposing it into an organizational context and to rearticulate it along the lines of collective action, power and bricolage-as-outcome. In the following sections of this paper we try to use *bricolage* to explore practices of movie special effects making.

STUDYING SPECIAL EFFECTS MAKING: OBJECTIVES AND METHODS

The inductive study presented in this paper has a twofold objective: We want to explore practices of making movie special effects with a particular emphasis on physical effects and the impact of technological change and the emergence of digital special effects as a competing set of practices. And we secondly intend to evaluate the usefulness of *bricolage* as a concept for analyzing local practices in an organizational context.

Initially, we had planned to spend several days over a three month period with the members of a French physical special effects group (Les Versaillais) in their workshop and in a studio in Paris. Unfortunately, our contacts had received an important mandate for a movie project to be filmed in Portugal and found themselves constrained to leave during the period that we had initially scheduled for observation (March to May 2003). For the present paper we therefore decided to base our analysis essentially on two extended interviews with one of the members of the special effects makers group (which included the visioning of original material filmed on the movie set of the French movie *Le Boulet* (2002)), a series of TV documentaries on the making of movie special effects (*Le cinéma des effets spéciaux*, Cinéfrisson, recorded between November 2002 and June 2003) covering eight movies with about 2 hours of material including movie scenes, documentation of effects making, and interviews with directors and effects makers, as well on a range specialized journals and magazines (SFX, Le technicien du film, Pixel) and internet resources (official movie and special effect firm's websites).

We developed a first set of ideas concerning the similarities and differences of local practices in the making of physical and digital effects based on individual and collective reading, visioning and discussing the source materials among the researchers involved. In parallel, we developed our understanding of *bricolage* based on our reading of Lévi-Strauss in

conjunction with the contributions on collective action, tactics, and arrangements outlined above. In order to structure our understanding of effects makers' practices as it emerged in the co-development of our theoretical position and the constitution of our corpus, we developed an analytical grid based on our understanding of *bricolage*, which we used to systematically analyze all materials in our corpus. The analytical grid allowed us to analyze the materials in our corpus for the type of illusion to be produced, the role and constitution of the repertoire, the ways in which objects (from the repertoire and from the outside) are put into relation with each other, the nature of the resulting arrangement, the role of power and constraints, and the type of collective action visible in the document. All sources were analyzed individually by both authors, and individual findings discussed and combined in various sessions to yield the synthesis of propositions presented in the findings section below.

Our study bears some obvious limitations due to the use of indirect sources. However, by combining sources directed at a general audience with more specialized information we tried to overcome some of the most obvious biases. The combination of different types of material (film sequences, text, interviews) and a constant reconsideration of theory and empirical materials helped to corroborate our findings. To us, the present paper constitutes a first attempt of exploring practices as well as their interaction and evolution in the area of movie special effects. The findings and conclusions drawn in this explorative paper will have to be substantiated throughout future empirical work including an increased effort of direct observation.

FINDINGS AND DISCUSSION

The findings presented below have been developed throughout several stages of analysis of the underlying material along the lines of the key concepts of *bricolage* outlined above. This section presents our findings concerning the principal characteristics of physical and digital special effects as well as their interaction. In the second part of this section we discuss similarities and differences of physical and digital special effects in terms of effect making practices and some of the implications these have for the co-existence in movie production of both modes.

Physical special effects

Physical special effects include mechanic, climatic and pyrotechnic effects as well as modeling and sculpting (Matarasso, 2002). They involve the construction of machines to produce illusions, e.g. a rain of volcanic ashes (e.g. *Dante's Peak* (1996); cf. figure 1), and the

production of particular objects that enter into the creation of an illusion, e.g. the model of a dam to produce a mud flood wave on scale 1:3 on an airport close to Los Angeles (Dante's Peak (1996); cf. figure 2). Physical effects are typically used for situations in which the illusion to be created includes natural settings, action and movement, and/or is directly related to the actors' play.

The making of physical effects involves a repertoire of physical objects in a delimited physical space (Matarasso, 2002). This repertoire is constituted depending of the particular kind of effects or environment the effects makers focus on. Some specialize in modeling, while others, for example, develop particular competencies in effect making in hostile natural environments (e.g. high altitude). Despite specialization the variety of arrangements assembled by physical special effect makers is high ("never two times the same thing" Matarasso, 2002; translation by the authors). This demands a high versatility and connectivity of the objects in the repertoire as well as a thorough knowledge about the potential utilizations that can be attributed to an object.



Figure 1: Dispersion of "volcanic ashes" (newsprint) on the set of Dante's Peak (1996)



Figure 2: Model of dam (scale 1:3) for Dante's Peak (1996)

The objects in the repertoire are heterogeneous both in terms of material and in degree of complexity. There seems to be one set of objects that forms the core of the repertoire and the material "capital" of a special effects firm. This material repertoire is coherent with the effect makers' experience base. Other, additional objects can be brought in more occasionally depending on a concrete project. In this sense, the repertoire of the physical special effects maker is not an entirely closed universe as in Lévi-Strauss's view of *bricolage*, but composed of a central physical space comprising a core set of objects (often used to assemble machines that are dis-assembled after the project) and several concentric zones of access to complementing objects that are activated for particular projects. It seems to us that networks of effect makers and suppliers of requisites, etc. play an important role in the making of a physical special effect. In this sense, the physical repertoire itself could be seen as being organized along networks.

The production of a physical effect is based on the conjunction of a varied set of competencies (like, for example, mechanics, chemistry, and electronics) which are needed to assure that the heterogeneous objects "hold together" [*qu'ils tiennent*]. Put in another way, one could say that the effect maker's prime competency consists in assembling extremely heterogeneous objects and putting them into action like, for example, by combining of ice, milk, debris, aircraft engines, fans, trucks, etc. to produce the illusion of a hurricane in the making of the movie *Twister* (1996) (cf. figure 3).



Figure 3: Creating an illusion of driving in a hurricane for Twister (1996)

Moreover, most physical effects demand the embedding of objects in a physical environment which itself does not belong to repertoire and is not under control of the effect maker. In consequence, the heterogeneous objects from the repertoire do not only have to hold among themselves, but they have also to go together with the physical environment in which the effect arrangement is situated in.

The uncertainty and lack of control over the objects that have to go together in the final arrangement typically lead to extensive experimenting, simulation and permutation, which often takes place in confined, and therefore controlled, experimental spaces (Matarasso, 2002). The remaining uncertainty about the exact unfolding of the physical special effect can be compensated to some extent on the film set by an effort to capture the arrangement-in-action from different angles using multiple cameras in order to allow for an ex-post selection of the viewpoints that produce the best illusion (cf. Figure 4).



Figure 4: Camera control screens on the set of Dante's Peak (1996)

Two types of objects enter into a physical special effects' arrangement: the objects that constitute the basis for machines can normally be dis-assembled, while others objects like consumables are often dispersed in the context of the arrangement-in-action. Machines are assembled on the basis of elements from the repertoire returning to the repertoire (with signs of usage and wear), whereas models are very often physically destroyed (through explosion, crash, etc.), which introduces a strong notion of uniqueness and irreversibility for many of the effects represented in our material.

The final arrangement of a physical special effect is characterized by a large number of elements (including objects and operators) which form an integrated whole with clearly defined physical boundaries that is under reasonable control and operational responsibility of the effects makers. Physical special effects arrangements thus correspond to de Certeaux's notion (1990) of an *espace propre* of an effects maker.

Once the objects entering into the arrangement are assembled, their heterogeneity is counterbalanced by the homogeneity of perspective, lighting, etc. that characterize the unity of the set. In other words, we could say that physical effects are characterized by their *material heterogeneity* as well as by their *on-set homogeneity*. (We will see below that the relationship of homogeneity and heterogeneity is exactly the inverse for digital effects.) Put another way, we would argue that the main integration task for the physical effects maker is to overcome material heterogeneity and to make things hold together. To put this idea in other words, we could say that the integration of the arrangement that is needed to create the

expected illusion is not only achieved materially, but also to a large degree accomplished through visual integration (especially by means of lighting arrangements) on the movie set.

Constraints for making physical special effects are much related to the physical environment in which the effect is to be put into action, and to the necessity to physically displace objects and arrangements. The materiality of the elements entering into construction creates a situation in which the re-production of an arrangement is almost as costly in terms of energy, time, and money, than the initial arrangement produced. In other words: the absence in physical arrangements of "copy" and "undo" represents a major constraint physical special effects makers have to take into account. Another type of constraint lies in the fact that an arrangement very often brings movie actors in direct contact with the objects used to produce the effect (cf. figure 5). The physical effects maker has to be ensured that no one on the movie set is being fragilized through the arrangement.



Figure 5: Actor Anthony Hopkins in a special effects arrangement in *The Edge* (1997)

A third type of constraints that enter into the arrangement has to do with the strong organizational interdependence on the movie set. Other than digital effect makers who tend to work in a mode of sequential or pooled interdependence (see below), the activation of physical effects arrangements is tightly linked to other activities on the set. This creates constraints related to the fundamental unity of time and place in a shot. A final type of constraint is also related to the set-bound nature of the physical effect. The set itself is traditionally the *espace propre* of the movie director who should exert control over everything placed in front of his camera, and the physical effects maker find himself in a situation in

which his own *espace propre* -- the effects arrangement -- is embedded in another actors dispositional sphere.

Collective action in the making of physical special effects is typically characterized by a large number of people working on the assemblage of the arrangement and its activation, a high degree of teamwork and commitment to the common goal of producing an effect. In the terms of Livet's (1994) classification of types of collective action, physical effects making clearly represents a case of *action commune* characterized by a common project, mutual adjustment as a means to reduce risk, a limited space-time arrangement shared by all involved actors, as well as the use of highly personalized (as opposed to standardized) objects.

Digital special effects

In most of the material analyzed for this paper digital effects were used in situations in which physical effects were too expensive or the heterogeneity of the physical objects such that an integration could not be achieved (impossibility to make objects hold together) like in the case of poisonous spiders crawling across an actors' face in the French movie *Astérix et Obélix contre César* (1998) (cf. figure 6). Other uses included adding elements of scenery with less richness of detail, for example for creating a roman amphitheatre in the movie *Gladiator* (1999) (cf. figure 7), relatively simple interior sets like in the opening scene of *Matrix* (1999) (cf. figure 8), or the incrustation of animated objects in cases where the requested flexibility of use could not be achieved through physical effects (modelling and animatronics).

The logic of interaction between physical and digital effects that can be found in most cases is one of complementarity. Virtual illusions are substituted for effects that are too difficult, costly, time-consuming to produce in a physical space, and they are consistently used to correct and optimize the illusion created through physical effects (e.g. by making the arrangement, cables, etc. disappear; cf. figure 9).



Figure 6: Digital effect in French movie *Asterix et Obélix contre César* (1998)



Figure 7: Digital adding of scenery (matte painting) in *Gladiator* (1999)



Figure 8: Virtual scene with incrustation of actor in Matrix (1999)



Figure 9: Complementarity of physical and digital effects in *Le Boulet* (2002)

The repertoire digital effects makers draw upon consists mainly of software and digital objects (both exclusive and publicly available). Some of our material indicates that digital effects makers have to be able to use any type of solution that is publicly available. In comparison with the objects entering into physical effects, a much greater emphasis seems to be put on tools. Recognition and legitimacy are based as much on the tools developed by a firm than on the concrete effects the firm has produced.

The arrangement constructed in order to produce a digital effect is characterized by the *material homogeneity* of the objects that are assembled. All objects being processed are digital in nature. Making objects "hold together" -- the fundamental problem in a world of physical effects -- is therefore not an issue for digital effects making. The principal challenge in the making of digital effects seems to lie in the *on-set heterogeneity* of the objects. While there seem to exist no special technical problems for incrusting or putting together various digital objects, the homogeneity that was assured in the case of the physical effect by the simultaneous presence of all objects in an identical time-space configuration is lost. Digital objects are often gathered from a wide range of sources and have been designed differently concerning, lighting, colours, texture, etc. In other words: while "cut and paste" allows for simple integration of objects, the principal challenge for digital effects making is to make the arrangement "seamless" (Anonymous, 2003). In one of the TV features a special effects coordinator working on the movie *The Time Machine* explains that the trickiest part of his work consisted in "keeping things photographic", i.e. ensuring that all virtual objects entering in the arrangement for a coherent and realistic photographic whole in terms of light, perspective, texture, colours, etc. Concerning another scene demanding the integration of a virtual set with an actor filmed on scene, the same person states that the most difficult thing to achieve was "combining all [virtual] elements into an actual live action set, and getting it all to live in the same environment photographically".

Even though digital effects arrangements are virtual in nature, they often have to rely on some sort of physical arrangement to facilitate the integration of the virtual and the real. The digital arrangement needs information about the physical space -- e.g. to orient a virtual object -- and often requires the application of physical markers on the set which supply this information and allow to position the virtual camera during post production (cf. figure 10). Other kinds of physical arrangements are needed to allow actors to position themselves and to unfold their play in a scene that is subject to digital effects making like in the movie *Multiplicity*, in which the principal actor is filmed and digitally incrusting in the same image up to four times (cf. figure 11).

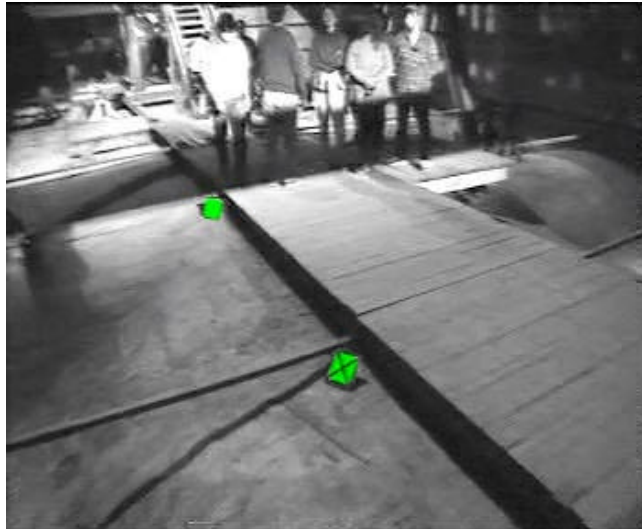


Figure 10: Markers set on the set of *Vidocq* (2002) to facilitate post production



Figure 11: Physical objects on the set of *Multiplicity* (1996)

Physical and digital effects find themselves in a two sided relationship. While some of the traditional constraints on physical effects making (e.g. the invisibility of cables, machines, etc.) shift towards digital post-production (which can easily take cables "out" of the image), digital effect making imposes new sets of constraints in the real space (e.g. green screens on which digital images will be incrustated, markers, etc.).

While the movie director's *espace propre* clearly is the film set, digital effects makers have in the last years enjoyed a comfortable degree of independence due to "technological opacity", their superior technical skills and the fact that they often work independently from one another on small pieces of the overall movie, free from the organizational interdependence constraining traditional effects makers. The movie director's means to integrate the two independent spaces of physical and digital effects making with the actual set, the actors, scenery, etc. is the storyboard (a graphical representation of the sequence of movie shots). In other words: the storyboard functions as a boundary object (in the sense of Leigh Star) tying together production and post-production by the only common language they dispose of: the image.

While virtually all cases analyzed for this paper remain in an overall logic of production vs. post-production with digital effects coming into play after the actual shooting is accomplished, some of our material indicates a tendency of digital special effects makers to position themselves *before and after* the physical shooting (Adolphi, 1999). This can be seen as an attempt by digital effects specialists to enlarge their dispositional power -- which is grounded in a proper space of technological competence outside the immediate reach of the director -- in the overall production process. Other sources indicate today a sort of counter-development in which movie directors try to appropriate themselves -- on the basis to their growing own experience with digital technologies and to the evolution towards real-time digital effects -- a growing portion of digital post-production. This could be read as an attempt to restore their traditional hegemony over the entire production process and to counter the dependency of the digital effects specialist which has built up during the last ten years, a period during which post-production has become more and more necessary to ensure the homogeneity of the overall visual production. In all movie material we have analyzed directors are present in the sphere of effects making. In some cases, the director even demands a co-presence of the effects makers on the set and urges digital effects makers to work in parallel with the crew on set to provide real time feedback (e.g. on the set of *Multiplicity* (1996)).

Compared with physical special effects the type of collective action to be found in the universe of digital effects making comes closer to the model of *action ensemble* (Livet, 1994). This model is characterized by individual effort which tends towards an integration of individual work at given moments in time, e.g. on the basis of a storyboard, detailed project planning, milestones, deadlines, etc.

Discussion

Despite their apparent differences in the material quality of objects, flexibility, reversibility, skills needed, etc. the question remains to what extent, physical and digital special effects actually represent clearly distinct universes of practices. Our discussion therefore focuses on the similarities and differences of both modes of effects making.

Closeness of physical and digital effects making practices

Studying both modes of effects making through the conceptual frame of bricolage shows that the differences between the two modes of producing special effects are probably less important than they might appear at first sight. The following points demonstrate the closeness of physical and digital special effects making:

Both make use of a very large number of tools and means. Physical special effects work on all kinds of materials with all imaginable instruments, and digital special effects are based on all available digital tools including work in 3D and 2D, fixed images as well as video and develop, if necessary, their own proprietary tools (Guilbert, 1999). The same kind of parallel can be found for a repertoire that in both cases exists prior to a concrete effects project and contains a large number of tools and objects. In the case of digital special effects the existence of such a repertoire can be related to the fact that the appropriation of a new tool is very time intensive, and that for this reason each digital special effects company has developed, over time, its proper toolbox that is composed of perfectly mastered and enhanced standard market solutions (all 3D software contains a programming language that allows the development of specific macros), and of special tools that have been internally developed.

Another point in common is that, a priori, special effects makers in both fields seem not to fear anything. Effects makers seem able to accept very open demands and are always willing to do whatever it takes to produce an effect. In both cases, effects specialists consider that what they are asked to do does not depend on technological innovation, but on an assemblage, in other words: a particular organization of (standard) resources at their disposition.

Both types of special effects have to embed their arrangement in a context of different nature: Physical effects in the overall set, digital effects into the image of a film filmed in a real environment.

Both types of effects making design an arrangement. For physical special effects this becomes obvious in the baroque assemblage of objects and technical systems (electrical, hydraulic, etc.) in order to constitute a machine whose only goal is to function. The same can be found for digital effects making when images in 2D are embedded in a scene in 3D, and when the resulting 3D video is introduced in a compositing software to be integrated, step by step, with the filmed scenes. The competencies needed on both sides to construct the arrangement are very open: mechanics, hydraulics, electricity, working on wood, metal, etc. for the first; 3D modeling, texturing, light effects, dynamic and environmental effects, integration and photographic gauging for the second.

Physical as well as digital effects making are subject to a dominant power structure represented by the director and his ideas and representations. It is him or her that ensures a convergence of the potentially divergent *bricolages* towards a fixed point, the construction of an illusion.

Both practices are based on an expertise that is an outcome of practical experience, and that is identified through concrete realizations (the participation in the making of a film) and/or a distinction obtained for prior work (e.g. an Academy Award ("Oscar")).

Finally, both activities are essentially rooted in simulation, based on phases of tests and necessary adjustments. This underlines the nature of the process leading to the outcome as *bricolage* as well as the idea that the arrangement is a "composition whose form is not a priori readable in the project that is at its origin and that defines its function" (cf. the section on *bricolage* as outcome above). In both cases, the arrangement is more a composition in evolution exposed to a large extent of contingency than the implementation of a precise plan. This is to a large extent related to the fact that the effects specialists are never two times asked for the same effect (Matarasso, 2002).

Differences in the making of physical and digital effects

Despite the parallels between the two modes of special effects making, several dissimilarities remain: While physical special effects are clearly put into action within the *espace propre* of the movie director, digital special effects continue to remain, at least to some extent, within the domain of the special effects firm. As we have argued above, this changes little by little in line with the tendency of post production becoming a phase often as

important (in terms of time and cost) than the initial production, and movie directors start controlling this phase more closely.

Digital effects follow a logic of experimentation and simulation that is fundamentally different from that of physical special effects by exploiting the two fundamental information technology revolutions of "copy and paste" and "undo". The digital machines rigorously follow mathematical laws that are perfectly reproducible while physical arrangements are always characterized by a rest of uncertainty that has to be accounted for on the set.

Digital special effects are produced according to a logic of *action ensemble* that is coordinated the storyboard as a conventional object and rigorous project management (with a plan based on the storyboard). Tasks are extremely segmented with individuals specialized by type of effect or by competence (modeling, lighting, climatic effects), by sets or by characters. Physical special effects on the contrary seem to depend more on the type of *action commune* in which one individuals work collaboratively on the arrangement to produce in a common and restricted space and time frame.

Despite these differences, a strong proximity in the practices related to the two modes of special effects making enables them to collaborate. Against common wisdom that would suggest an incompatibility or a struggle for influence given the high importance of information technology in the digital effects making as compared to the very hands-on crafts solutions proposed in the field of physical effects and their potential substitutability, the encounter of the two modes of special effects making does not resemble the confrontation between the world of the *bricoleur* and the world of the engineer described by Lévi Strauss (1966). Both can co-exist in a non-conflictual way as long as the movie director regulates the context in which their interaction takes place and has the final word on the real image. Both modes of special effects make heterogeneous (either materially or visually) objects "hold" through the ideas and demands of the movie director and through a general shared "visual culture" [*culture de vue*]. The potential for conflict however would probably emerge if the camera itself became virtual, thus altering the equilibrium between the two types of effects making in most movie productions.

CONCLUSION

The brief conclusion we would like to propose for this first exploration of the different yet complementary universes of movie effects making practices concerns the method employed as well as our view of the future development of the interrelation of the two sets of practices.

***Bricolage* as a methodological and theoretical position**

From our point of view, the concept of *bricolage* fills a theoretical and methodological void in the analysis of practices. Existing approaches tend to be either more macro oriented and situated on a structural level or have a very strong micro orientation. Situated between these two, *bricolage* represents an intermediary level concept that provides access to local practices without the necessity of engaging in heavy ethnographic research. As we have tried to illustrate with this paper (initially more by necessity than by prior conviction -- but the results of our analysis convince of the usefulness of doing so), the analysis of *bricolage* is based on observable categories like "repertoire" and "arrangement" that allow the use of indirect sources. In other words: the analysis of *bricolage* can do without the actors' symbolic representations. Its "economy of method" makes *bricolage* an interesting point of view in the exploratory stage of a research project directed at understanding everyday action.

From a theoretical point of view *bricolage* puts a much needed emphasis on objects, techniques and the relations between objects and persons. It avoids at the same time some of the problems related to other contemporary approaches like, for example, actor network theory (Latour; Callon) which rely very much on a conflict perspective that centers on the power relations and the confrontation of protagonists. *Bricolage* neither uses proto-militaristic language (like actor network theory's idea of an "enrollment of objects" into a project), nor does it center on the notion of power. Through the notions of constraint and functionality of the arrangement it remains on the other hand open to discussing power relations. It also retains a strong notion of symmetry in the analysis of human and non-human "actants" -- a central claim in actor network theory -- and focuses not on objects or persons but on their relationships (with, of course, an obvious risk of overstating the relational aspect of action) in order to develop a deeper understanding of the conditions, constraints and unfolding of human action. Other theory traditions like, for example, ethnomethodology or symbolic interactionism put an equally strong emphasis on interaction but tend to concentrate on the symbolic side of interaction and not so much on the physical interaction of elements.

Evolution of special effects making practices

Our analysis of physical and digital special effects making practices leads us to develop a set of propositions about where the two sets of practices might be heading in the future. Our initial question was to see to what extent practices related to the making of physical special effects would be likely to change under the influence of technological

progress leading to increasingly compelling digital effects making. If any conclusion can be drawn from our analysis, it is that both sets of practices appear closer when looked at from a perspective of *bricolage* than they seem from a purely technologically focused point of view. Both practices come relatively close to the concept of *bricolage* as it has been developed in the first part of this paper. It seems that it is their common foundation in a set of practices of *bricolage* that enables special effects makers from both "sides" to engage in a complementary action oriented towards the "seamless integration" of both physical and digital arrangements in an overall visual illusion for "creating scenes where the viewer can't tell what's an effect and what's not is starting to have a big impact" (Anonymous, 2003: 51).

If we were asked to make a hypothesis about the future development of the relationship between the two types of practices we would say that it will probably not be so much the practices of special effects making that will shift with a further development of digital technologies. From our interpretation, further technological changes will rather impact on the role of the movie director whose work will have to incorporate to an increasing degree the management of boundaries between the movie set and the universes of physical and digital effects making. In the future, the biggest challenge for movie directors will be to design the optimal mix of the two types of effects and to integrate both physical as well as digital effects makers around to final image to be created. In this situation, new organizational actors emerges which have the necessary competence to supervise, to coordinate and to integrate both kinds of special effects making (e.g. the French company EST (*Etude et Supervision des Tournages*)).

We consider this paper as a first move towards developing the notion of *bricolage* into a useful concept for analyzing meso-level organizational phenomena, and as a first essay to develop a deeper understanding of the possible impacts of technological development on special effects making practices. Questions that warrant future explorations include the role of networked repertoire, the development of the boundary conditions between different types of actors in movie production and the role of boundary objects, the emergence of new roles, models and competencies for movie directing, and the emergence of new types of actors that specialize in assuming integrating roles.

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