# The Black Box

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**Abstract**

In societies where industrial conditions of production prevail, the artist's equipment tends to become a black box. The photographic camera and the computer, for instance, are essentially black boxes. The contemporary artist increasingly confronts technologies and systems whose internal operation appears mysterious. The very tools on which her creative work depends are fundamentally opaque. Many digital artists and designers, for instance, use computers without understanding even the basic principles of computer hardware or software engineering. They depend on tools whose mechanism is veiled in ignorance. The opacity of the artist's equipment, which is unprecedented in the history of world art, is a defining feature of what is often called "media art".

The principal purpose of this essay is to clarify the fundamental properties of the black box, to describe its role in contemporary media art, and to suggest various possible courses of action in response to its ubiquitous presence. I claim that the "black box" is the fundamental concept of media art theory, because it defines the specificity of its object. The technical is always already intertwined with the social. This essay argues that the concerns of media art theory must be reconsidered in recognition this fact.

**Keywords**

Actor-network theory; apparatus theory; circuits; experimental media; black boxing

## Introduction

In societies where industrial conditions of production prevail, the artist's relation to her equipment is subject to a process that I shall term "black boxing". The contemporary artist increasingly confronts technologies and systems whose internal operation appears mysterious. The very tools on which her creative work depends are fundamentally opaque. Many digital artists and designers, for instance, use computers without understanding the basic principles of computer hardware or software engineering, or even the algorithms that underpin widely used image filters. Their work depends on artifacts whose mechanism is veiled in ignorance. The opacity of the artist's own practice, which is unprecedented in the history of world art, is a defining feature of what is often called "media art".

The principal purpose of this essay is to clarify the fundamental properties of the black box, to describe its role in contemporary media art, and to suggest various possible courses of action in response to its ubiquitous presence. I will describe the black box via a sequence of particularizing approximations, beginning with a general characterization and then adding more and more specific details.

## Assemblage

First of all, a black box is an assemblage of actants. This initial characterization is based on the work of Bruno Latour, Michel Callon, and other sociologists in the tradition of Actor-Network Theory (ANT) (Latour 2005).

Classical social theory often regards tools as inert or passive vehicles for the execution of human plans, and so lacks a suitable vocabulary to describe the contribution of non-human agents. To make up for this lack, ANT relies on the concept of "affordance", developed in the branch of psychology known as ecological optics (Gibson 1986). The word "affordance" denotes the action possibilities that characterize an object. A cup "affords" grabbing, lifting, drinking, pouring, throwing, spilling, shattering, kicking, and many more actions besides. Our purposeful actions do not exist in isolation from the objects that authorize, facilitate, support, and encourage them. Agency does not belong to a single center of action, such as a rational person capable of making choices. Rather, agency is distributed across the whole ensemble.

A person can act only in the context of the possibilities afforded by things, animals, other persons, etc. It is thus misleading to describe action solely as a human responsibility. We may wish to say, instead, that any activity is distributed over a network of human and nonhuman agents. But the word "agent" confusingly suggests that inanimate objects like cups, chairs, and computers have conscious intentions, which would amount to blatant anthropomorphism. To avoid this implication, ANT replaces the word "agent" with the alternative term "actant", borrowed from the theory of narrative literature. An "actant" is any element that plays a part in an action, without necessarily formulating plans or forming intentions. I shall henceforth say that the skills of an actant are "articulated" through the affordances of other actants. The word "articulation" is meant to highlight the reciprocal co-construction of the various participants in the ensemble. To take up Latour's famous example: A person holding a gun becomes a criminal, and a gun held by a criminal becomes a murder weapon (Latour 1999).

**Apparatus**

I do not claim that every assemblage constitutes a black box. The description needs to be refined as follows: A black box is an assemblage bearing a functional character. It has a predefined range of possible inputs, plus an internal mechanism that determines how those inputs reliably produce certain outputs.

This functional character is normative. There are "proper" ways of using the device, and these must be learnt. Thus the device is designed for a subject capable of learning, a subject whom I shall call the "compliant user" or "operator". The role of the compliant user is defined mainly in virtue of the skills required to operate the device.

I shall henceforth speak of the system of categories built into the standard usage of a functional thing as the *repertoire* of that device. Aperture, focus, and exposure time belong to the repertoire of photography. *Competence-in-use* consists in setting the correct inputs to realize whatever intentions the operator has. A repertoire is a stable distribution of responsibilities between actants in an ensemble. The photographer must know how to operate the machine; the machine must produce a reliable result.

The repertoire of a black box can be understood in part as *the compliant user's sense of what is possible*, the experienced limits of what can be done with the device. To comply with the device is to master its repertoire. The personal intention of any compliant user constitutes an individual articulation of the chosen repertoire. The compliant user learns to select one or more of the predefined inputs, with the intention of producing some outcome. The operator of a device is not a universal subject but a historical set of norms created (consciously or not) by the engineers and designers who planned the device (Maidell 2002, 8).

Prague-born philosopher Vilém Flusser, who had a keen awareness of the prevalence of the black box in contemporary life, wrote extensively about the philosophy of photography. The photographer, Flusser argued, believes that she is using the camera as a tool, and so as an instrument of her will. And this is in a restricted sense true, since a photograph is in most cases the realization of a photographer's intention. But the artist can only intend what the camera can do. To take a photograph is to make a selection out of the range of possible choices already built into the design of the camera. The intention of the user is constrained by the range of inputs that the system is designed for. Flusser puts the point forcefully:

> In the act of photography the camera does the will of the photographer, but the photographer has to will what the camera can do (Flusser 2000, 35).[1]

The compliant user often relates to such a device as one thing rather than as a multiplicity. It is natural to describe the camera as one entity with its own intrinsic properties and powers. This compliance underpins the conviction that every art form involves a distinct medium with its own essential properties. Compliant users are convinced that they know what photography essentially is, because the repertoire that characterizes their usual mode of interaction with the device has been relatively stabilized. This stabilization is often sustained by institutionalized social practices, such as the curricula of media art schools and the contents of textbooks and instruction manuals, so that its obviousness appears to lie beyond discussion.

But a medium is not a thing with intrinsic properties. A medium is an ensemble. The existence of "electronic arts", for instance, presupposes a collective of actants that range from the human electricians to the switches, accumulators, electrodes, electrons (etc.), without any of which no work could possibly get done. The entities that enter into an ensemble comprise the *inventory* of that ensemble, and the relations between entities in this inventory comprise the ensemble's *composition*.

I shall henceforth use the term *reification* to describe any practical attitude that relates to an ensemble as if it were a single thing bearing essential properties and powers (Lukacs 1971). To forestall any reifying interpretation, then, I propose to replace the term *medium* with the term *apparatus*. An apparatus is a functional ensemble of actants where the distribution of tasks and responsibilities is organized around a stable and well-understood repertoire (T. De Lauretis and S. Heath 1980). To describe an apparatus is to describe its inventory, composition, and repertoire. A black box is an apparatus, in this sense.

**Circuits**

Consider the mainframe computers of the 1950s and 60s. The computer was not directly connected to the printer. The circulation of the tape required the presence of human operators linking the programmer with the mainframe computer, and the mainframe computer with the printer that would output the results (Ceruzzi 1998, 96). By thus "mediating" between these various actants, the operator sustains the integrity of a circuit that has been previously disaggregated into a sequence of distinct stages.

A *circuit* is an apparatus consisting of several micro-apparatuses arranged into input-output chains. The outputs of one stage become the inputs of another stage. In some instances, the input of one stage is also the output of the same stage. An example is the process of conveying a parcel through a courier service, where the parcel is supposed to arrive intact. In other cases, the element that circulates must undergo changes, which can be reversed at a later stage in the circuit. The original textual input of an electric telegraph system must be recoverable at the end of the transmission process. In contrast, some systems, such as a water purification plant, are designed to produce irreversible changes in their inputs.

The analysis of a black box will pay special attention to the ways in which circulating elements are preserved and/or transformed. It will also describe the vulnerabilities to which the process and its elements are subject. For instance, the transportation of a parcel is subject to damage. I shall use the term *tolerance* to describe the vulnerability to loss or damage of the components of a circuit.

In many cases, the compliant user need not worry about the circuit's internal composition. The sender who relies on a courier service does not normally concern herself with the processes that deliver the parcel to its recipient. But there are circumstances that drive users to seek out greater intimacy with various stages of the circuit. An artist who calls on a courier service might, for instance, avoid sending an artwork on a Friday if she knows that the parcel will sit in a hot storage room over the weekend. The wish to avoid certain points of vulnerability will thus sometimes drive users to seek out greater understanding of the stages in a circuit.

At every stage in the circuit, the circulation process can be diverted, temporarily delayed, or permanently blocked. A *gatekeeper* is any actant capable of blocking, delaying, or diverting passage across the circuit. The concept of gatekeeping was proposed by social psychologist Kurt Lewin, who argued that many social processes are circuits where members of some pool of resources (food, people, money, etc.) can potentially reach, or fail to reach, some destination via a chain of steps. Each step corresponds to one or more gates (Lewin 1947).

Gatekeeping functions are not the exclusive province of human agents. Examples of gatekeepers include not only the switchboard operators of a telephone network but also the logic gates of an electronic computer.

The presence of a gate always implies the possibility that a given flow may fail to occur. A gate must by definition be capable of blocking circulation. The actant who desires passage *depends* on the gatekeeper, and this dependency increases when the gate is an obligatory one. An obligatory passageway is a gate whose

keeper has been rendered indispensable in virtue of the organization of the circuit. Every circuit is a network of dependency relations.

An obligatory passageway is often guarded by a special kind of actant, the *spokesperson*: one or more human agents who take it upon themselves to articulate or explain the behavior, identity, interests, thoughts, desires, or tendencies of other actants (Callon 1986, 25).

A spokesperson is not necessarily a gatekeeper, but many gatekeepers are also spokespersons, and many spokespersons either are, or desire to become, gatekeepers. The spokesperson often defines the terms of a problem such that their solution requires passage through a particular gate (Ibid., 26). This strategy defines the gate in question as an obligatory passageway, and so cements the social power of the gatekeeper. An admissions tutor in a university program, for instance, "solves" the "problem" of the excess of applicants for a given number of student places by establishing a method of selection.

A circuit often contains *points of aggregation*. These are moments that bring different actants together for a (more or less) definite period of time. The aggregation is often subject to gatekeeping. Members of a committee must normally be appointed or invited. Participation in a film or art festival requires approval by a jury or selection panel. Aggregation points can, however, arise without the intervention of a gatekeeper, such as for instance crowds that are spontaneously formed. One of the tasks of a critical apparatus history is to identify and describe the gates and aggregation points of a circuit, as well as the processes (debates, negotiations, tests, etc.) that take place in them.

A circuit, then, is a special kind of apparatus whose inventory consists of functional micro-apparatuses arranged into input-output chains, subject to damage and other forms of vulnerability, and punctuated by the presence of gatekeepers, spokespersons, and points of aggregation. A black box is a circuit, in this sense.

**Automated circuit**

More specifically, a black box is a circuit whose operation has been relatively stabilized. Its existence, inventory, and composition are taken for granted, and are no longer subject to discussion and controversy. Given certain user input(s), the device should be capable of generating the expected output(s) without any further human judgment. Once a photographer has clicked on a camera, for example, the machine should produce a picture without additional assistance.

When the actual outputs do not confirm habitual expectations, users typically assume that the device has malfunctioned and so call upon specialists to repair or recalibrate it. Human intervention is excluded only while the device works as intended. But this assumption cannot be made as a matter of course. Describing the modern computer architecture, scientist John von Neumann observed: "The remarks… on the desired automatic functioning of the device must, of course, assume that it functions faultlessly." (von Neumann 1945, paragraph 1.4)[2] The category of automatic functioning thus embodies an idealizing assumption. It is ideal in the sense that perfect performance cannot be absolutely guaranteed. "Malfunctioning of any device has… always a finite probability." (Ibid., paragraph 1.4) The fact that a certain input will automatically produce the expected output will not necessarily be realized in practice. The possibility of failure is an essential feature of any automatic system.

At stake here is the question of intimacy with an apparatus. Intimacy often manifests itself in the ways people handle malfunctions. The person who is not intimate with the device is not equipped to respond to malfunctions, because this requires seeing the device not as one entity but as an ensemble. The malfunctioning device often loses its apparent unity and splinters into a collection of parts that have to be inspected, tested, and perhaps modified or replaced. What was once treated as one is now viewed as many (Labour 1999, 183-4).

The console of an IBM 7094 mainframe computer, for instance, had rows of small blinking lights indicating the state of each bit in the various registers of its central processor. Media historian Paul Ceruzzi had described how human operators were able to read the binary content of every register directly, and if necessary execute a program instruction by instruction: "Such 'bit twiddling' was exceedingly tedious, but

it gave operators an intimate command over the machine that few since that time have enjoyed." (Ceruzzi 1998, 73)

Intimacy is mobilized in a particularly urgent fashion when malfunctions occur. Knowing what to do in response to apparatus failure is a criterion of an agent's intimacy with the circuit. A compliant user often cannot respond to malfunctions, and so must depend on operators who are themselves intimate with the circuit. The existence of compliant agents who must accept such a dependent relationship due to their lack of intimacy with the apparatus is an essential property of every black box. The operator becomes a spokesperson for the device, explaining the failure and prescribing a solution, as well as a spokesperson for the user, specifying the nature of her problem and offering one or more possible courses of action.

**Media Art Theory and History**

In other words, *a black box is an apparatus that has become "opaque" to the compliant user*. To understand the black box is to understand the historical sources of this opaqueness. And to understand those sources is to reconstruct the formation and development of the black box. As Latour has noted, the history of a black box often reveals the presence of uncertainties, doubts, hesitations, debates, failed attempts, repeated trials, and fierce controversies (Latour 1987, 4). The aim of a theory of the black box is to recover the history of a black box "in the making", and so no longer taken for granted.

Consider for instance the case of film art. The standard way of writing its history and theory takes the black box for granted. Virtually every mainstream treatise written about film aesthetics, for instance, typically enumerate and analyze the possible ways in which the repertoires of the cinematic black boxes can be used artistically. To this end, they often include sections on framing and composing the shot, selecting a camera angle and position, designing the color and lighting, moving the camera, editing the film, etc. The fundamental categories built into the design of the black box are thereby taken for granted. This kind of media art theory therefore highlights and celebrates the creative actions of talented compliant users, such as the canon of great directors. I have no intention of denying that users of a black box can produce works of substantial artistic value. But the standpoint of the compliant user is not the only possible way of writing the theory of art.

An alternative approach might for instance direct attention to those artists who have struggled to open the black boxes on which their practice depends. Instead of praising the standard canon of film directors, theorists would examine those artists who engage experimentally with their black boxes. In contrast to the compliant user, an "experimental" user confronts a black box with nonstandard inputs, even though such actions are widely regarded as 'inappropriate', as they fall outside the design concept that underpins the apparatus.

Nam June Paik's *Magnet TV* (1965), for instance, consists of a magnet attached to a cathode ray tube monitor.[3] It presupposes a sophisticated understanding on the artist's part of the device's internal operation. By demonstrating that the device affords alternative methods of making images, the artist declines to settle into the subject position of the compliant user.

The history of video art and (especially) experimental cinema is rich with examples of artists who refuse to be interpellated as users. Stan Brakhage's four-minute film *Mothlight* (1964), for instance, abandons the standard method of shooting moving images. The film was made by placing various leaves and insects between two layers of tape, which were then processed by a film printer.[4] Brakhage's actions can be viewed as acts of learning, whereby the filmmaker struggles to learn the possibilities that the thing can afford. This sort of work involves a search for alternative methods of input and/or output. Thus the use of the device is also a form of exploratory learning of the device. To rewrite the history of "new media" as the history of the formation of its black boxes also involves writing the history of changing modes of learning and discovery. The historical approach proposed here would therefore direct attention to the ways in which the repertoire, inventory, and composition of a black box are discovered, tested, debated, and rejected or stabilized. It would also describe in detail the ways technologies are taught and learnt, as well as the networks of dependency that arise through the presence of gatekeepers and spokespersons throughout the circuit of media production and distribution. This historical reconstruction is the principal task of a critical

media history informed by the theory of the black box.

(Endnotes)

1 A different edition is available online at: http://korotonomedya2.googlepages.com/VilemFlusser-TowardsAPhilosophyofPho.pdf

2 All subsequent citations from this report, which contains the basis of the so-called "von Neumann" architecture, will reference paragraphs rather than page numbers.

3 http://www.medienkunstnetz.de/works/magnet-tv/

4 A low-resolution video version of this work can be viewed online at http://www.youtube.com/watch?v=XaGh0D2NXCA. The full power of the work, however, can only be appreciated on celluloid.

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