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Towards a cognitive definition of photographic media

Tool-making technologies develop in response to material needs and challenges, while information technologies respond to human cognitive needs such as curiosity about the world and enjoyment of fiction. In my presentation today I want to identify some of the cognitive processes and corresponding technologies underlying the historically unprecedented appeal and cultural success of the photographic media, including still photography and film. I want to argue that the attractiveness of photographic images, still or moving, results from an interaction between their unique technical properties and human innate cognitive preferences and biases involved in processing visual information. In particular, the technological and cognitive properties of photographic media include the following:

1) the indexical character of photographic images, involving the physical connection between object and image, underpinned by human instinctive alertness to indexical signs;
2) the illusion of realistic movement inherent in film, which taps to human automatic attention to moving object;
3) the iconic character of photographic images, involving perceptual resemblance between object and image, supported by a cognitive tendency to assume identity or direct connection between objects that happen to be similar;
4) the rectangular photographic frame, which privileges an individual observer by limiting the angle of vision and creating composition within the frame. Cognitively, the "window" of the frame taps to human innate environmental preferences to seek useful information by means of adaptively advantageous opportunity of seeing without being seen.

In a pre-digital age both still photographs and the animated photographs of cinema were generated by a photochemical process of exposing to light silver salts covering a celluloid strip in the camera, which darken in the presence of light. After developing and fixing the photosensitive image, the resulting negative was re-photographed to make a positive, realistic looking black-and-white print, which is what viewers

contemplated in their photo albums or on the cinema screen. In digital photography capturing images of objects is essentially the same, even if the technology of recording light effects is electronic rather than chemical. The now practically universal digital cameras employ a CCD (charge-coupled device) image sensor to record objects from the outside world, which are subsequently converted into a stream of integers (whole numbers) attached to picture elements (pixels). The main reason why the photochemical process has been replaced by a digital one is practical and economic: digital cameras produce and copy their images practically at no cost (no need for film stock), and instantaneously (no need to wait until the negative is developed and re-printed).

Whether the underlying technology of capturing light effects to represent the visible world is photochemical or digital, the huge popularity and cultural success of the photographic media have also depended on the perceptual and cognitive processes involved in contemplating photographic images. Quite apart from *what* photographs or films show, there is something uniquely appealing, or *photogenic*, in the photographic images themselves. Arguably, the communicative effectiveness of photography and film is ultimately a function of the media's inherently *indexical* character, combined with human innate responses to indexical signs. Just as a photographic image is physically caused by light reflected from an object, so an index is a sign physically caused by something in the outside world. For example, a crater in the ground caused by an exploded bomb is an index of that bomb, and loud music audible from an adjacent apartment is an index of a stereo system (and by extension of people using it) located in that apartment. Indexicality understood as causality treats any physical change in the environment as a sign pointing to a usually displaced object that subsequently determines the meaning of an index. In other words, as a physical extension or trace of an object an index is a referential representation of that object.

For evolutionary reasons indexical signs tend to provoke instinctive, goose bumpy sensations combined with anxious inferences about the character, identity and possible intentions of their spatially displaced originals. We fearfully become aware of someone's presence in the dark by the sound of their breathing, and we are making a reasonable deduction that a cracking sound of a broken twig in the forest may be a sign of an approaching large animal or a stalking human. Indexes and their displaced originals tend to be cognitively treated as gestalts, as co-present and consubstantial

wholes, even if index and its referent are separated in time and space, like a photograph and the object it represents. Despite the temporal and spatial displacement, however, a photograph and object are instinctively perceived as "identical". The famous early nineteenth-century photographer Louise Daguerre referred to photographic images as "imprints of nature," while the writer Edgar Allan Poe found that "the closest scrutiny of the photographic drawing discloses only a more absolute truth, a more perfect identity of aspect with the thing represented". Making a point of the fact that the lens, the basis of photography, is in French called the *objectif*, the influencial film critic and theorist André Bazin stressed that the originality of photographic media, as distinct from originality in painting, depends essentially on the "objective character of photography", in which "between the originating object and its reproduction there intervenes only the instrumentality of a nonliving agent", and whose images are "formed automatically, without the creative intervention of man". For the cultural critic Susan Sontag too a photographic index is "a trace, something directly stencilled off the real, like a footprint or a death mask".

Unlike a painted image, a photograph is therefore an objective proof of the object's existence (as in CCTV camera footage accepted as forensic evidence), because the relationship between index and object is causal and physical, at least at origin. Despite being spatio-temporally removed, for compelling psychological reasons things represented in photographs and films seem uncannily still to be "there", as the viewer subjectively "re-attaches" the missing physical object to its indexical image. André Bazin went so far as to insist that for the viewer "the photographic image is the object itself", thus endorsing the "naïve" reactions of early cinema audiences, who reportedly often screamed and dodged when a train hurtled towards them on the screen. Sustained stress and frustration too can both diminish critical sense by making a person mistake displaced indexes for their originals, and weaken the need to suspend disbelief, normally used to enjoy fiction as fiction, when contemplating indexical simulations of life on the screen. In Woody Allen's film *The Purple Rose of Cairo* (1985), an unhappy housewife Cecilia, played by Mia Farrow, finds emotional fulfillment in watching every night romantic comedies and musicals in a local cinema, until a dashing young hero, played by Jeff Daniels, "steps off" the screen to join Cecilia in the real world, later to invite her to pursue romantic adventures with him in his own black-and-white virtual reality inside the screen.

The irrationality of the photogenic effect bears a striking resemblance to the universal phenomenon of contagious magic identified by anthropologists, which too relies on mistaking displaced indexes for contiguous objects. This type of magical thinking follows the psychological law of contact or contagion, based on the belief that things that once have been in contact with each other remain always in contact, even when physically separated. In this way a sympathetic, "magical" link is assumed to exist between a person and a severed part of that person, such as hair, nails, or teeth, or some physical trace left by the person, such as a footprint. It as a world-wide superstition for example that by injuring footprints one could also injure the feet that made them. The Australian natives from south-east of the country used to believe that a man could be harmed by placing pieces of quartz or charcoal in his footprints. As in contemplating photographic images, in contagious magic a person acts towards a displaced index as if it was the object itself. This archaic default mindset seems to reject the passage of time and the changes it brings—a disposition only overridden by a conscious effort to learn the objective cause-and-effect links between objects and events in the world. But even for otherwise rational people the residual contagious magic is often too compelling and emotionally gratifying to resist, as evidenced by our nostalgic, sentimental attachment to mementoes, keepsakes, family photographs and home videos.

Both still photography and film remain closely related as indexical media—the only difference being the added illusion of movement in the latter, which technically consists of the effect of the intermittent flashing of still photographs supported by the phenomenon of the persistence of vision, in which the perception of an object continues for a split second after the rays of light proceeding from it have ceased to enter the eye. The possibility of film camera rested on the confluence of several inventions: short enough exposure time to allow multiple exposures per second (silent films were generally recorded at 14 to 16 frames per second); the invention of a transparent, flexible film base (developed by George Eastman in 1889); and the adaptation of the Maltese cross drive mechanism, previously used in machine guns and sewing machines, to advance the film and hold it still for a fraction of a second. As in still photography, the immediate popularity of moving pictures in the late nineteenth century was mainly due to their perceptual and cognitive appeal: for evolutionary reasons motion (quite regardless of *what* is actually moving) automatically catches our agitated attention. Throughout our prehistory moving, self-

propelled, laterally symmetrical objects tended to be either animals or other humans, and it paid in survival terms to keep a watchful eye on what these objects were doing: did they behave like friends or enemies, did they look like potential sources of food or like potential predators. Our vision is instinctively alerted by movement, as evidenced by the greater effectiveness of flashing neon signs over still lights, by TV commercials over printed ads or billboards, and by the higher visual appeal of performances in motion such as theatre, dance, and cinema over painting, photography, sculpture, or architecture.

Despite its effectiveness in pointing reliably to a causally linked object, displaced indexicality has its limits as a form of communication. Index alone can often imply its referent only vaguely, leaving too much to conjecture and speculation. An imprint of a shoe sole in soft ground clearly indicates a past presence of a walker, but not much beyond that: the shoe size can dimly imply the walker's age, but not his or her sex, physical appearance, or any other of the many important personal characteristics and circumstances of life. On the other hand, the cinematic image—with its high degree of realism and objectivity based on the assumption of the physical connection with the represented objects, plus the illusion of movement, which further enhances the representation of the animated world—depends on something more than indexicality. Photographic media owe their communicative effectiveness also to their high degree of perceptual resemblance to the represented objects. In other words, in semiotic terms photographic images are *iconic* as well as indexical. Unlike an index, an icon is not caused by an object it represents, but is related to it through perceived similarity. For example, a person's photograph is an index caused by and therefore physically inseparable from that person, but a painted portrait (an iconic sign) only resembles the person it is referring to. Apart from the similarity between the painted portrait and the sitter, which exists in the minds of those contemplating the picture, there is no direct, physical connection between the two. Iconicity in the above sense is abundantly illustrated in human communication and culture, most spectacularly by figurative drawing, painting, and sculpture.

In fact, all signs are polisemiotic, in that they embody properties of more than one type of sign, thus enhancing their communicative power. When an index such as a photograph resembles its object perceptually, which it nearly always does, we are talking about the iconic quality of an indexical sign, or about *iconic indexes*. Iconic indexicality covers a fascinating area of visual culture, including some of the most

perceptually and cognitively powerful media and art forms such as the shadow theatre, magic lantern shows, silhouette portraits, the camera obscura, photography, film, and television. It is the combined effect of iconicity and indexicality that makes these media all the more efficatious in stimulating our senses, emotions, and imagination than the purely iconic art forms such as drawing, painting, and sculpting. The iconic indexicality of a shadow puppet, a silhouette portrait, or a photograph implies not only iconic resemblance, but also physical identity with the represented objects in a way never attained by purely iconic media. In other words, iconic indexical media are "truthful" in depicting already existing realities, whereas iconic media are fictional in simulating often non-existent, imagined realities.

Incidentally, the communicative power of iconic signs seems to be enhanced by another universal "irrational" disposition, identified by anthropologists as homeopathic magic. Just as in contagious magic a displaced index is treated as a contiguous sign, whereby doing "harm" to one's footprint is believed to affect the person who made the foorprint, so homeopathic magic is based on the principle of similarity, whereby things that resemble one another are believed to possess an invisible but direct link, so that by manipulating the icon one can also manipulate the object depicted by the icon. Like an angry crowd burning a hated public figure in effigy, or a lover "punishing" a disloyal partner by tearing up his or her photograph, so homeopathic, or imitative magic assumes control over the object by controlling its image. In Greek mythology the sculptor Pygmalion famously creates an image of a beautiful woman, then prays to Venus for a bride modelled after the sculpture, and has his prayer granted when the goddess obligingly turns the cold ivory into a living body. This famous myth plays on the universal irrational disposition, underlying the homeopathic magic, that identifies an iconic sign with its referent (found also in idolatrous worship of religious images). But however emotionally gratifying, mistaking icons for objects remains an illusion, as artists more sober than Pygmalion can confirm. To a lady who once complained about Matisse's painting that "the arm of this woman is much too long", the painter famously replied: "Madame, you are mistaken. This is not a woman, this is a picture".

Another important feature of the photographic image, still or moving, to attract and hold the viewer's attention is its rectangular shape, the frame, which limits the natural angle of vision, enhances concentration, and determines the image's composition by creating semantic tensions between objects enclosed within the frame.

While the two naked eyes capture a horizontal field of vision of over 180 degrees, the normal camera lens (55 mm) permits only a 43-degree viewing angle, while a 300-degree telephoto lens further narrows it down to a mere 8 degrees. The horizontal and vertical edges of the photographic frame separate the represented scene from the rest of the imagined and real world, and in the process create a composition, in which selected visual elements assume meaningful spatial relationships and tensions, absent in the scene when viewed with a naked eye. In other words, framing not so much highlights meaningful relations between objects as creates relationships that did not exist before, even when this meaning-creating process is unplanned, as in casual snap-shot photography and spur-of-the-moment smartphone video capture.

Choosing the framing as the basis of the picture's composition started with Renaissance panel painting, when the humanist Leon Battista Alberti compared the picture frame to an open window through which an artist saw what he wanted to paint. In addition to creating a composition from the selected parts of the visible world, both the window, the photograph, and the cinematic screen also offer the viewer an advantageous opportunity of seeing without being seen. Humans innately prefer edges rather than open spaces for better visual access to an area, and spaces that provide a covering over the head (a roof, a tree canopy etc.) to ensure privacy and safety. The vertical edge of a bush and a horizontal covering of a tree branch as the optimal hiding and viewing position may well be the evolutionary prototype of a window and a picture frame. The evolved responses to landscapes make a contemplation of enclosed views more pleasant and enticing, including also the expectation of "mystery", defined as the promise of more information as one ventures deeper into the landscape, physically or imaginatively. The use of geometric perspective in Renaissance painting, and the automatic recording of cues of depths in photography to simulate three-dimensional space in a flat picture, are thus designed to invite the viewer to explore the virtual scene within the frame as part of the vicarious experience that imitates our ancestors' exploration of the natural environment in search of optimal habitat. For deep cognitive reasons the photographic "view from a window", coupled with the indexical and iconic qualities of the image itself, thus becomes what is probably the most appealing and perceptually powerful visual medium ever invented, or, given the stable elements of human innate cognitive dispossitions, ever likely to be invented.