THE RHETORIC OF THE JPEG

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As a method of compression for digital photography associated with the World Wide Web, the JPEG is today the default mode by which we experience on-screen images. Curiously taken for granted in discussions around digital photography, this paper asks what is at stake in the development and implementation of this standard, and proposes that the JPEG is a social and ideological phenomenon.

JPEG compression artifacts (saved at low quality) Image credit: Daniel Palmer.

Fifty years ago, Roland Barthes famously called the photographic image "a message without a code". [1] Barthes was concerned with its illusionary transparency or 'photographic paradox', the double structure of what he called 'denoted' and 'connoted' meanings operable in the reading of any photograph. Three years later in his essay "The Rhetoric of the Image" (1964) – hinting at the medium's indexical nature that later preoccupied him in *Camera Lucida* – Barthes tells us that the relationship of signifieds to signifiers is not one of 'transformation' but of 'recording'. As such, he argued that *reading* a photograph involved relating it to a rhetoric – all the social codes within which signs make sense to readers (including the function of postures, expressions and gestures; associations evoked by depicted objects and sequences; and accompanying text). Yet the image itself, Barthes argued, is "a message without a code", since being "captured mechanically" it does not involve "rule governed transformation."

Charge-coupled devices (CCD) were already under development when Barthes published those essays. By 1969 CCD sensors could convert photos to electrons, collecting light and converting it to a voltage charge and a numerical code. And by the mid-1970s, computer programmers set to work on developing

compression techniques that would eventually lead to standards such as JPEG and TIFF. Digital photography is encoded all the way through, in elaborate algorithms built of zeros and ones, yet this code remains as invisible as the social codes that govern the reading of images. Under normal circumstances, when we see a digital image on-screen, or printed on paper, its numerical basis is repressed. The makeup of the image only becomes visible when the algorithms are pushed, typically in the form of cosmetic disturbances such as jagged edges. Usually undesired, compression artifacts – and other blocky raster effects – are like the accident in Paul Virilio's economy of speed, unforeseeable but substantive. Compression artifacts have themselves become the basis for creative exploration, most famously in Thomas Ruff's *jpeg* series, which ironically demand to be seen in the flesh, rather than on-screen.

What is a JPEG? The Evolution of a File Format

As a method of compression for digital photography closely associated with the World Wide Web, the JPEG is today the default mode by which we experience on-screen images from computer monitors to mobile devices. According to a 2011 press release from the official site of the Joint Photographic Experts Group that gave their name to the format, over a trillion JPEG images have been created (see www. JPEG.org). The same press release states that the format has "contributed to the progress of e-commerce, where digital images offer new opportunities in the form of products and services" and that "the existence of standard image coding formats" has been an "enabler" of our "digital imaging ecosystem". Facebook and Flickr are celebrated as part of that ecosystem, while the growth of the online pornography industry is unsurprisingly neglected (Thomas Ruff once again draws our attention back to this them in his *Nudes* series).

Most photographers and media theorists – surely everyone reading this – know that the JPEG is a technical standard that specifies how continuous-tone image data is compressed into a stream of bytes and decompressed back into an image. Beyond that, the JPEG is strangely unknown, almost completely neglected in the critical literature around digital photography. On the one hand this is unsurprising; after all, most photographers barely understood the history of Kodak, Agfa or Fuji film stock either. It was just a neutral substance, and the choice to use one or the other was based as much on habit as aesthetic preference. As for the (art) history of photography, where the final image is privileged, discussion of the technical means of its production is considered vulgar (even as this is a regular topic of conversation among photographers themselves). But the JPEG is different from film, since it is not something we choose to use, being built into cameras and the default file-sharing format. Undoubtedly its history – buried in reports and technical releases – is obscured because it appears so 'natural', and so concurrent, to the digital era. And indeed, its history is unremarkable. Following early research in the 1970s around the 'discrete cosine transform', international standards bodies began the push for an image compression standard in 1982. The resulted in the formation of the Joint Photographic Experts Group in 1986 – as a joint committee between the International Organization for Standardization (ISO) and the International Telecommunication Union (ITU). The official standard dates to 1992 in Geneva.

As part of that "general interface between systems of equations and sensory perception" – as Friedrich Kittler describes computing – the JPEG format was designed to exploits the human eye's differing sensitivity to chrominance and luminance, to discard information that the eye cannot easily see. [2] Essentially this means the so-called 'redundant data' of subtle color distinctions and high frequency brightness variations. However, since the quality of the image declines as this data is removed, JPEG compression is considered 'lossy'. The original format offers only 8 bits of data per color, providing a relatively coarse

256 levels between complete darkness and complete brightness. Images containing large areas of a single color, such as blue skies, are therefore particularly prone to compression artifacts. Nevertheless, a 20:1 compression ratio can be achieved without noticeable loss of quality. If rhetoric is classically defined as "the art of adapting discourse, in harmony with its subject and occasion, to the requirements of a reader or hearer", the rhetoric of the JPEG involves reducing an image's file size to the minimum without drawing attention that loss.

Smaller file sizes are useful for two obvious reasons: to save memory or disk space, and for faster transmission across networks. Since JPEG compression was developed at a time when memory was expensive, camera makers welcomed more images fitting on a memory card. Moreover, the release of the JPEG format coincided with the first popular graphical web browser, NCSA Mosaic, in 1993, quickly followed by Netscape, Interent Explorer and the popular explosion of the Web in the mid-1990s. In those early years, so-called 'progressive JPEGs' divided image files into a series of scans for progressive rendering as they loaded over slow dial-up modem connections. Each scan gradually improved the quality, with the image slowly loses its blurriness and becoming clearer. But even this did not stop me from choosing the option of 'turning off images' in the browser preferences – an option still available on many web browsers.

As Lev Manovich suggested in 1995, rather than "an aberration, a flaw in the otherwise pure and perfect world of the digital", "lossy compression is increasingly becoming the very foundation of digital visual culture." [3] Indeed, amateur photographers have proved unexpectedly content to accept a lower quality image for the convenience of digital speed. Kodak, in particular, eventually admitted their early miscalculations on this front. As the bulk of their profits had come from manufacturing film, Kodak came belatedly to promoting digital cameras for obvious reasons – and not least as they mistakenly believed that film sales would continue to flourish simply because celluloid produced a superior image. Kodak, perhaps more than any other company, should have realised that economics and efficiency always win out over image quality.

Image quality remains the primary discourse in which JPEGs are understood by the photographic community. A typical online photo-lab will offer advice regarding the level of JPEG compression that "will not lead to visible loss in quality or detail." More dramatically, a best-selling guide to Photoshop proposes that: "shooting in JPEG mode is like taking your film to a high street photo lab, throwing away the negatives and then making scans from the prints." [4] The argument here – spurred on by the rise of so-called RAW and DNG (digital negative) files – is that JPEGs are degraded, even inauthentic, copies. It echoes a common misconception about JPEG images that they degrade each and every time they are opened. For serious amateurs and professionals, RAW and DNG files are akin to 'digital originals'. Even more than compression is at stake: JPEGs are associated with 'destructive editing' and tied to 'in-camera' processing of qualities like colour balance and sharpness, as opposed to the ability to post-process such settings in software like Photoshop, Lightroom or Aperture. In many respects the RAW vs JPEG debate thus updates the craft versus automation tension that Julian Stallabrass discusses in his 1996 essay "Sixty Billion Sunsets". [5] On one hand, the drive behind JPEG-producing point-and-shoot camera design is to automate what used to be called 'previsualisation' –most recently including smile-activated shutters and 'face recognition' that prioritise the focus and exposure when a familiar face appears in the frame. Stallabrass' argument – that relieving the camera user of manual control has the paradoxical effect of *mystifying* the camera's processes – still holds. Indeed, iPhone apps even play with the automated 'developing' of JPEGs in nostalgic ways (leading to recent minor controversy when photojournalist Damon Winter won an award for using the Hipstamatic app in Iraq). On the other hand, the economics of film-less photography also encourages photographers to 'over-sample' the subject, and defer their

imaginative conception of the image to its post-processing. The increasingly widespread awareness that to post-process JPEGs is to risk an avalanche of artifacts has at least focused attention, among serious amateurs, to file formats, including the issue of the proprietary nature of RAW files and format obsolescence.

More importantly than image quality, the JPEG format is part of the new computational logic of photography. Crucially, all digital cameras also save JPEG files with EXIF data – an acronym for Exchangeable Image File. The term exchange is key here. The camera model and settings such as shutter and ISO speed, aperture, capture date and time, focal length, metering and flash mode, and geolocation are all stored as metadata – helping to enable images to be catalogued, searched, shared and used. Likewise, descriptive tags – increasingly semi-automated via software may also be built into the JPEG image via EXIF data. This metadata is fundamental to the workings of photo-sharing and social networking sites, and is part of the way the JPEG protocol enables *interoperability*. [6]

The Ideology of the JPEG?

The underlying question in this paper is: in what sense is the JPEG file format significant to or even determining of photographic cultures? That is, what are the unexpected consequences of a file format that has become the universal standard? My approach borrows from the emerging field of study known as 'software studies'. Lev Manovich, pioneering the field, has argued that there is no such thing as digital media in general, no "properties of a medium", only operations and affordances defined by software. [7] More recently Manovich has argued that software studies aims "to investigate both the role of software in forming contemporary culture, and cultural, social, and economic forces that are shaping development of software itself". [8]

Jonathan Sterne's work on the mp3 as an historical, cultural and political phenomenon is instructive here, enabling us to think about the JPEG as a format whose ubiquity across devices facilitates particular photographic practices. As Sterne notes, the mp3 is a form designed for massive exchange, casual listening and massive accumulation. As he argues: "The possibility for quick and easy transfers, anonymous relations between provider and receiver, cross-platform compatibility, stockpiling and easy storage and access" were all "built into the [file] form itself." [9] Precisely the same can be said of JPEG. Adrian Mackenzie, in an article on 'codecs' in Matthew Fuller's book *Software Studies: A Lexicon*, has shown the complexity of examining the MPEG format, arguing that its performative calibration, within precise "psycho-perceptual parameters", "refers implicitly to a great number of material entities ranging from screen dimensions through network and transmission infrastructures." [10] All of which is also true of JPEG.

Paul Caplan has recently argued that "protocols such as JPEG and XML 'determine' a new scopic regime characterised by network relations which is built around a discourse of 'the archive' and an ideology of visual democracy." [11] Caplan describes the JPEG as a protocol object, so familiar that it has "become transparent and taken for granted." [12] In this sense JPEG extends the discourse and sales pitch of photography, which has always been one of ease of use, accessibility and openness – that it is, "a nominally democratic medium". But as Caplan also observes, "this discourse of participation is clearly ideological when these imaging practices are located within the complex relations of ownership, control and power". [13] The new scopic regime is articulated around networks that are closed, proprietary, its "image spaces, existing as part of new media giants' such as Yahoo and Google's portfolios of dataspaces primed for mining and advertising, are actually private commodity spaces". [14] Borrowing,

among others, from Bruno Latour's 'actor-network theory' and Graham Harman's 'object-oriented philosophy', Caplan treats "the jpeg compression protocol as an 'actant' doing things in the world: making images findable and viewable in browsers; making them small enough to be distributed and exchanged in mobile spaces; playing a part in Facebook's face recognition business plans and Apple's App store domination." [15] The JPEG is thus 'enfolded' in imaging practices and industries, not to mention the economic-political relations of Web 2.0.

In the popular imagination, the JPEG stands for the democratisation of image making and the global distribution of the image. Take the rise of the amateur in news reporting. Iran was labelled 'The JPEG Revolution' on the front page of the *International Herald Tribune* newspaper in 2009. Indeed, we can be grateful that the JPEG is a royalty-free, open-source codec established by a non-profit UN-style organisation. Yet the primary motivation of the JPEG committee is to accelerate the adoption of new imaging products and services by the market. Today, as Caplan notes, images must become JPEGs, either captured or converted as such, if they are to find a place within social media. [16] By making the JPEG standard freely available, software publishers and hardware manufacturers can integrate support for the new file format into their products. Furthermore, the openness of the format is far from guaranteed. For instance, the JPEG committee recently formally adopted JPEG XR – extended range – as part of the continual evolution of the format. Although what was eventually ratified is an open format, Microsoft had hoped to retain some proprietary control when it submitted its 'HD Photo' format to the international standards organization in 2007 with greater dynamic range, a wider range of colors, and more efficient compression.

In 2010, Google – as part of its "make the Web faster" effort – announced a new WebP graphics format (pronounced 'weppy') with claims that its use could cut image file sizes by 40 percent. In a move that once again demonstrates the socio-technical basis of digital aesthetics, WebP has a tendency to blur images rather than create a JPEG like blocking – and is therefore better for facial skin tones in particular. Earlier this year, Google quietly slipped this potential 'JPEG killer' into Gmail, Picasa and its Chrome browser. If used, these Google interfaces automatically and invisibly convert JPEG images to WebP. Google's move is directly related to its effort to push their new web video format, WebM. In any event, faster file transfers and lower network burden are obviously attractive for Google, who point out that images make up 65% of the typical data of a web page. But there are penalties: encoding and decoding WebP images takes significantly more distributed computing power. And while both WebP and WebM are open formats, we should never forget that all the data around online images gets mined to become part of valuable algorithms to be patented and used to direct the unpaid labour of online attention through which audiences provide the basis for the advertising economy.

After twenty years, the JPEG is a powerful incumbent – built into every camera, Web browser, image-editing program, pharmacy photo-printing kiosk, and mainstream operating system in existence. These material environments illustrate the complex forces and relationships within which practices of digital photography operate, and invite us to move away from perspectives that seek the essential characteristics of the technology. By virtue of its ubiquity and association with the Internet, the JPEG is rhetorically tied to the idea of democracy in an age of distributed imaging, in which the image has been spatialised in global databases. More broadly, the very manner in which computer software in general separates the (image) interface from algorithm "makes it a powerful metaphor for everything invisible that generates visible effects, from genetics to the 'invisible hand' of the market", as Wendy Chun has recently argued. [17] The rhetoric of the JPEG, its persuasive power, lies in this same invisibility. As with the very idea of 'analogue photography', perhaps only once it is outmoded will the JPEG move into the critical light.

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