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Better than Silver Halide

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IT-Enquirer conducted an interview with David Spencer from the SpencerLab Digital colour Laboratory in New York, a technical research expert when it comes to printing, colour engines and all things related to photo printing. We asked some obvious questions and got some not so obvious answers.

Our focus was on the big three (Canon, Epson, and HP) as they reflect the largest part of the market. Our first question was whether there's any real difference between the print quality of these three vendors.

"According to our tests, differences in realism, richness, sharpness, smoothness, and graininess vary more by model within each vendor's consumer photo printer product line than by vendor. The latest top-of-the-line models that we have tested from Canon, Epson, and Hewlett-Packard—when used with their corresponding (OEM) recommended inks and best media—all produce print quality that appears to be fully competitive with conventional silver halide prints that consumers might obtain from their local retailer or on line," David Spencer said.

SpencerLab also found that mixing the inks and papers with those of other vendors is risky in that they are designed to be optimal as a system and should be judged together within each vendor's product offering. Using the vendor's inks with the vendor's paper therefore seems to be the best way to go.

Still, some people will replace the vendor's inks with inks that cost less or have a quality and longevity that they claim to be better than that of the vendor itself. Lysonic inks comes to my mind, although not mentioned by Spencer. Refills are a market in their own right, but what's the trade-in?

Spencer: "Since printer OEM vendors invest significant R&D to increase the quality of their inks, it is possible that a third party could; however, new inks are usually introduced with new printers and perhaps new media and even new print heads, so just changing the ink may not be enough. And we all know that "better" has a lot of meanings. OEM printer vendors worry about many, many aspects of print quality—richness, bleeding, water fastness, light fastness, abrasion resistance, etc.—how will "better" be measured? "Better" is a very complex tradeoff, and OEMs spend considerable effort just in understanding how much of which characteristics are important to consumers, professionals, and other user constituencies."

Spencer said: "Longevity has become a popular print quality metric, but this was perhaps initially promoted to offset the decreased colour gamut typically available in pigment-based inks. As improvements in gamut of such pigment-based inks are brought to market, dye-based inks with improved media are chasing the longevity usually associated with pigments." That way we are now at around the 100 years life time for an average Epson or HP print.

SpencerLab found that the top-of-the-line models of the current generation of photo printers pretty much meet consumer expectations. "Each generation of printers continues to improve on its predecessors—in inks, in media, in print heads, in colour tables, etc. Other factors, such as ease-of-use, are becoming more visible. Perhaps one of the biggest reasons for consumer dissatisfaction now is the use of the wrong ink or media—or the wrong settings between the camera and the printer (and especially the computer and printer driver, if they are in the flow)," said Spencer.

So far, David Spencer hadn't talked about the issue that seems to be the most important if you have to believe some vendors' marketing campaigns: resolution. His analysis was surprising: "Many consumer silver halide prints are made with digital processing, even with conventional film input. Resolutions may be only near 300 dpi. However, each picture element can contain full colour (this is also true for photo printers that use thermal dye sublimation technology)."

However, inkjet printers create dots.

David Spencer: "Inkjet dots are of much more limited colour; typically just the single colour of the ink. Therefore, emulating a picture element requires many multiple dots, each quite a bit smaller (higher resolution) than the picture element. The challenge is to make the dots small enough so that they are not seen as graininess—especially in the light pastels where the number of dots must be more limited."

According to Spencer, this is also the reason that additional inks, such as light magenta/cyan or grays are desirable: "Much of the issue here is dot size, not dot placement (addressability)—both part of "resolution". Printing at a higher resolution setting may not increase sharpness, especially if the printer incorporates advanced technologies such as variable dot size and additional inks."

Spencer is used to analyzing consumer behaviour and so he knows about consumer preferences very well.

He noted that since consumers seek simple metrics to compare print quality, vendors such as Epson have pushed “resolution” in order to advertise higher and higher numbers. “ However, selecting options such as one-directional printing (where available) may increase print quality more than increased “resolution”; some HP photo printers default to a best photo mode that may produce prints as good as their highest resolution setting—and much more quickly,” concluded Spencer. He also added that inkjet photo prints may appear sharper than silver halide, even at modest (for inkjet) “resolution” settings.

Another factor that we thought is an important one, is the number of inks to use. David Spencer already briefly touched on that issue when he said that light colours that are added to the common four can improve on the smoothness of a print. At Magnum Photographers, they seemed very pleased with the quality they got from printing with a 6-ink DesignJet 130. But some Epson, Canon and HP photo printers now incorporate as many as 8 different inks.

Spencer: “Epson’s R800 includes Red and Blue inks to increase its colour range (gamut). In one of our research projects, consumers preferred prints from an 8-colour HP printer over those from competitive 6-colour photo printers. HP employs light cyan and light magenta in the DesignJet 130, which is quite sufficient for many situations. The DesignJet 130 indeed produces beautiful prints. Colour tables matter, as does dot size (as discussed above)—there are many ingredients (some secret) in the print quality soup.”

Quality isn’t everything. Cost is important too, in production environments as much as for consumers. Inkjet printers are said to be costly in terms of ink spillage. Epson is an infamous example of how you can deplete an ink cartridge without printing much: some cleaning cycles consume a lot of ink. Spencer quoted an Epson user guide, “You can also turn the printer off and wait overnight—this allows any dried ink to soften—and then try cleaning the print head again.” However, he too noted that some printers use excessive amounts of ink in some of their cleaning cycles (which may not be counted in corresponding yield claims).

Another myth wants it that single-ink cartridges are inherently less expensive to use than three-ink cartridges. Spencer: “Since cartridge cost and yield are critical to determining the true cost-per-print, and most photographs do not contain one predominant ink colour (blue skies are cyan and magenta, green foliage is cyan and yellow, skin tones are yellow and magenta, etc.), single ink cartridges alone do not assure cheaper print costs.”

SpencerLab Digital Colour Laboratory has tested multi-ink cartridge printers that exhibited lower cost-per-print than single-ink cartridge printers, and vice-versa. “The best measure is a standard, representative yield test coupled with cartridge costs to calculate cost-per-print; I am co-chairing a committee chartered with developing such a standard for the ISO.” Spencer also noted, “some vendors are offering a combined ink-and-media package that guarantees a certain number of 4 by 6 inch (10 by 15mm) prints at predetermined cost-per-print (29 dollarcents each from HP and Epson, for example).”

Finally we asked about the colours photo printers can print, and whether it makes sense to have the ability to print many millions of colours.

“It is just a calculation,” according to Spencer. “If the computer uses 8 bits to describe each of the three primary colours (RGB), there are 16,777,216 possible digitally-specified colours. Whether you can see a difference between all pairs of two adjacent ones when they are printed on a particular printer is another story that most companies do not address. Also, there may be parts of the human visual colour space that go beyond this computer capability,” said Spencer. And he asked a surprisingly subtle question: “Do you want to see the difference between adjacent colours, or is that an artifact, ruining a smooth blend with a contour?”

Spencer added, “Since it is a matter of calculation, if black (or light cyan, or gray, or orange) provides additional colours, you can calculate more than 16 million. Light colours reduce grain, as noted above. Orange and green and red and blue inks can increase the saturated colour gamut. Even if additional ink colours are available to increase a printer’s gamut in different modes, only 16 million colours are available within any one image if the camera or computer is only providing 3x8 bits of image data (even though Photoshop can do internal calculations with 16-bit precision).”

David Spencer’s views on photo printing put me back with my feet to the ground. Perhaps it’s time to forget about all the hype and start looking at the result...