Raster versus Vector: A Graphic Design Primer

Thomas Corcoran

DeVry University

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Since its release in 1990 on the Macintosh operating system, Adobe Photoshop has been a developing industry standard for photo editing, image manipulation and raster graphics creation (Mahesh, 2011). Raster graphics are defined as "assemblages of pixels on a 2D grid system that can be viewed on computer screens or print media" (Dabner, D., Stewart, S. & Zempol, E., 2014, p.201). Most electronic and printed images, logos, and other designs we all see from day to day are displayed as a raster graphic once they are in their "final" rendered form either published in a magazine, newspaper, book jacket cover or published to a website, for example. Tiny dots, called pixels on a computer monitor, made up of millions of possible colors are the essence of raster graphics. Conversely, vector graphics are defined as "lines and curves defined by mathematical objects called vectors" (Wood, B., 2015, p.178). One of the most popular vector graphic creation programs is Adobe Illustrator, which began as a publically available Mac-only application in 1987 (Dill, 2015). Since vector graphics are drawn using mathematic equations, and not made up of pixels, these graphics are resolution independent, meaning that they can be scaled up and down with no loss of clarity like would happen with raster graphics due to the set number of pixels. Both raster graphics and vector graphics have their place in the modern graphic design world. This paper will cover these two contrasting types of graphics, some use cases for both raster and vector graphics, the software each type is created with, as well as information about the associated file formats.

One of the most basic differences between raster and vector graphics is their resolution dependence or independence, respectively. Due to their nature, raster graphics are resolution dependent. This means that the raster image is made up of a set number of pixels. When scaled up to a larger size (or zoomed in), raster images lose their sharpness and the edges become

pixelated. Advancements in Adobe Photoshop allow for some scaling to take place with minimal loss of clarity, but scaling beyond approximately 120% tends to produce grainy, rough edges, splotchy colors, and a degradation of details. Raster graphics also tend to be designed at a specific resolution depending on whether the design is for print or web. If the raster graphic is for print, typically the resolution will be set at 300 dots per inch (dpi) or higher depending on the final print format. Some print designs can be as low as 100 dpi, like posters, because they are viewed from a distance. Other print formats require higher dots per inch such as a images for a professional magazine. Raster graphics for the web are typically set at a resolution of 72 pixels per inch (ppi), the standard for web-based viewing, although many modern computers, tablets and mobile devices have screen resolutions much higher than 72 ppi. In contrast, vector graphics, being made up of mathematical objects, are resolution independent. This means that they can be scaled up and down the no loss in resolution and edges remain crisp since they are not composed of pixels while they are being designed or if they are saved in the appropriate vector file format, which is discussed further in this paper.

This resolution dependence/independence lends each of these graphic types to particular use cases. Raster graphics, in the design phase, tend to be used for manipulating photographs or other artwork saved in a raster graphic format. This includes changing colors, cropping images, removing backgrounds, adjust brightness/contrast, removing objects, fixing scratches or imperfections in photos, compositing multiple photos together as one, and other typical photo editing tasks. A photo or other image will be brought into a program like Adobe Photoshop and corrections or manipulations will be performed using the tools and effects available in the software. So, one of the primary use cases for a raster graphic will be displaying a photo-like image which is designed at a set size and set resolution for either print or web. These images

usually start out as raster graphics, such as digital camera photos or scanned images, and they end up as raster graphics for their final file format. When manipulated, a raster graphic is having various aspects of pixels changed or removed. Vector graphics, on the other hand, are used for designing any graphics which need to be scaled. They are typically illustrated graphics created by an artist drawing directly on the digital canvas. A possible vector graphic example could include a company logo which appear as small as a business card, product packaging, or website logo and as large as a billboard or printed on the side of a semi-truck trailer. An item like a logo could be created in a raster graphics editor such as Adobe Photoshop, however that logo graphic would need to be designed at the largest size with the highest resolution ever possibly needed and then resized down to meet smaller uses. This is why it is easier to design graphics such as logos in a vector drawing program. When modified, vector graphics are having aspects of the mathematically rendered object modified such as the angle of a curve, thickness of a line and overall size of an object.

As stated in the introduction, the most common raster graphics creation and editing software is likely Adobe Photoshop. It remains a graphic design industry standard for photo manipulation, image editing and raster graphics creation on both the Mac and Windows PC platforms, and Adobe Photoshop has more than 10 million users (business.com, 2017). Other competitors such as Adobe Fireworks (formerly Macromedia Fireworks) have come and gone (Boman, 2013). Several other raster graphics programs have emerged in recent years including GIMP, a freeware raster graphics program, and other commercial titles such as Pixelmator, a Mac-only raster editor and Affinity Photo software. Generally, these programs are less expensive but also slightly less powerful in terms of their toolset than Adobe Photoshop (Krum, 2013). For vector graphics, Adobe Illustrator is also likely the most commonly used software. With its long

history, Adobe Illustrator tends to be the de-facto choice for illustrators and vector graphic professionals. However, there are other choices when it comes to creating vector graphics. Though it is thought of as a raster graphics program, Adobe Photoshop has the ability to draw vector graphics using the pen tool. Affinity Designer, a competitor vector drawing application, has many of the same toolsets as Adobe Illustrator. Another program, Inkscape, has been around for a while and it offers vector graphics tools for free as an open source software (Ferron, 2017). These programs all have the ability to allow the designer to draw illustrations and create graphics which are vector-based, with various levels of sophistication.

When it comes to file types, raster graphics are generally saved as .JPG, .PNG, or .GIF for use on websites or displayed on social media. These file types were developed specifically for digital images (in the case of .JPG) and web browsers can render these images as they all contain pixel data for the raster graphic. The more pixels in the image, the larger the file size tends to be. Another raster graphic file type is the .TIFF file format. This format was developed for high-end professional printing from page layout programs such as Adobe InDesign and QuarkXPress (Lundquist. Unknown date).

To retain their resolution independence, vector graphics would need to be saved in a file format which retains the mathematical equations for reproducing that graphic. These formats include .AI, .SVG, .PDF, and .EPS. Adobe Illustrator's proprietary project file format is .AI which will retain all vector graphics as mathematical objects. Similarly, .SVG (Scalable Vector Graphic), .PDF (Portable Document Format), and .EPS (Encapsulated PostScript) are vector graphic formats for final output of these files (Lundquist. Unknown date). The .SVG format is typically used for rendering vector graphics in a web browser, whereas .PDF is used both online and for printing, and .EPS is used in print. The final output of vector graphics is often saved in a

raster graphic format such as .JPG or .PNG. An example of this would be a logo, created as a vector graphic, saved as a .PNG with a transparent background and placed on a company website. Once saved in a raster graphic format, the image is comprised of pixels and is no longer created using mathematical objects as a vector graphic. The image then would be manipulated in a raster graphics editor like Adobe Photoshop.

In conclusion, it is important for designers to realize the differences between raster and vector graphics. Each type has its place within the design workflow. Many designs such as posters, brochures and infographics take advantage of both raster graphics, such as photos taken with a digital camera, and vector graphics, like a chart, graph and logo, within the same page layout. Combining raster and vector graphics in this way takes advantage of the strength of each type of graphic.

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