New Color Management Technologies

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The purpose of this study was to inform people about new color management technologies. These people are consumers and creators within any industry; even though this paper focuses on graphic designers in the graphic communication industry. These technologies will allow consumers to break out of the color management shell. Now, there is no need to rely completely on color management specialists.

This study investigated the advantages of one particular device: the ColorMunki. In order to do this, the ColorMunki was given to graphic designers in San Luis Obispo, California. They were asked to use the ColorMunki for a week and to write down their likes and dislikes about the ColorMunki. The common threads were put together in charts to determine whether the ColorMunki was a success or not.

Results from the two graphic designers indicated that the ColorMunki is a very acceptable new color management tool. They used the device successfully and were happy with the product. However, more research was conducted to confirm the benefits of the ColorMunki. The ColorMunki was compared to a similar, more expensive device, the i1Pro. Those results showed that the ColorMunki, while significantly cheaper than the i1Pro, captures highly accurate color samples.
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CHAPTER I: INTRODUCTION

Graphic communication is an industry that entails a wide variety of disciplines. Topics include everything from printing, publishing, packaging, digital imaging, graphic design and others. Each segment is different in their own way, but together make up the graphic communication industry. There is one common aspect that is important to the graphic communication field: color management.

Color management is the core of quality print. In a perfect world, a subject or object in reality could be precisely represented in a print. However, in the reality, this is not the case. Input devices have to communicate to a computer, which in turn has to communicate to the output device. Some devices have a color space that is different from another device, which will alter the colors in a picture or document. Color spaces are the range of colors that a device can be reproduced. As a result, the colors seen on the screen will be different than how they are printed. Color spaces explain why many colors vary from the original to the print.

Each design component, such as a camera, screen, and printer, have a different color space. The color space for the input device can either have an sRGB color space or an Adobe RGB color space. The hue with the values of red=88, green=249, and blue=17 in the Adobe RGB color space is a very vibrant green. Using those same values in the another color space will not create the same color. The same values in the sRGB color space create a dull yellow hue rather than a vibrant green. For example, a camera might use a standard red, green, and blue (sRGB) color space, while the output device may have its own color profile made for that specific device. If the camera uses an Adobe RGB space, the color could turn out a different color. While color spaces depict the values of Red, Green, and Blue in numerical measurements, the hues can be different. Hues are the way in which colors are seen according to their wavelength. In the professional world, there have been steps taken to try and streamline this issue. Creating standards for how digital input and output devices communicate color information was the first streamlining idea done by the professional world. The International Color Consortium (ICC) has created a system for making profiles that have become standards for print companies to use to make color management
more consistent. Developments in calibration techniques have also helped to solve the problem of color management. It is important for consumers and people within the graphic communication industry that this color problem is managed. Some consumers do not understand why the colors they see in life are not the colors they see on their final printed product. However, through new color management techniques, more consumers are educated on the topic of color and its reproduction.

While color management is a new topic for the consumer in the printing industry, printing companies have been dealing with color management for decades. These companies already have a rough idea of how to manage color reproduction. Printing companies start the color management process by finding which ICC color profiles and color spaces work best for their equipment. To make color consistent, a printer had to make a color profile for their output device. Color profiles will allow the devices in a specific workflow to work together to produce the best color possible. Printing companies then need to communicate to the consumers why some colors might not print the same as what they see in a picture or on a computer screen. Printers cannot produce all the colors that a human eye can see. Explaining this will ensure that there will be no surprise to the consumer when the color they receive on their printed product is not the same as they saw originally.

Another topic that the printing company needs to address is how they will compare a proof to the final printed product. Proofing means before production on a project starts, that project has been approved by the customer. It is a way for the customer to see a sample of what their final product will look like. There are two types of proofs: hard proof and soft proof. Printing a sample of the project and giving that printed piece to the customer for approval make hard proofs. Soft proofing means that everything is approved on a computer display. It is important for a printing company to produce the same quality on the end product as it looked on the proof that was originally given to the printing company’s customer. There are new technologies that are helping the proofing process become more efficient and precise. The issues of color spaces, calibration, and color profiles all come together to create a holistic look at the necessity for color
management.

It is evident that color management is needed in the graphic communication industry. However, most of color management has been focused on the print or reproduction of color. As mentioned, there have been many steps taken to try to streamline the process of color management within a printing company. For instance, color profiles and different proofing options are some advances made.

Still, this just focuses on helping the printer manage color. There is another segment of the graphic communication industry that has been largely ignored: graphic designers and consumers. Through new color management tools, graphic designers and consumers are becoming more interested in the subject of controlling color. One new tool can allow graphic designers to create a document with more precise colors from computer display to print. Even consumers who did not understand how color could be reproduced are now becoming color experts themselves by using these new tools. Together, a revolution is being created. It is not just the printers anymore who are interested in color, it is also graphic designers and consumers.

The purpose of this study was to examine the new color management tools that are catching the attention of graphic designers and consumers. This study will show how these new technologies are being used in the graphic communication industry, and how they are beneficial. By first acknowledging the importance of color management, it will be clear why these new technologies are taking the industry by storm. Researching new color management tools will show how color management could be more widely used. It will give an insight into some new gadgets and programs that are not known to most graphic designers and consumers. By allowing graphic designers to test drive some of these new devices, reliable feedback will be given on whether they are successful or not. These graphic designers can give insight into what they think the pros and/or cons of the new technologies present. Knowing what color management techniques have worked in the past for printing companies will allow people to see how much the technologies are changing. What used to be a specialized subject is now becoming easier to manage by not only the printers, but by graphic designers and consumers alike.
CHAPTER II: LITERATURE REVIEW

It is important to figure out why color management is important in the graphic communication industry. One of the reasons is to close the gap of color differences between the color on a computer display and the colors on a printed product. Jacci Bear, a freelance graphic designer and writer of desktop publishing for over two decades, states some reasons as to why color is never the same.

- Monitors use additive red, green, and blue color while printing uses subtractive cyan, magenta, yellow, and black pigments, each a different way of reproducing color.
- In print, ink layering and overlapping causes subtle shifts in color not found in the individual pixels that make up a screen image.
- Printed images don’t have the same range, saturation, and contrast as a monitor making the colors typically darker and less vibrant than on screen. Paper texture and brightness also affect, and change the printed image.

Color management depends on a set of variables. All of these items, such as the color ranges and type of red green and blue used, need to be controlled in an effective color management workflow. A graphic design may look great on a computer display, but can print differently. For example, a graphic design document may have a line of color on one layer of the document, then a line of a different color layered above that. On the display, those two lines of different colors look exactly as intended. However, when those two lines are printed, one color will print first, then the next color will print over it. If not designed properly, the colors will overprint and blend together when printed, creating a different than desired. The most important fact is that printers just do not have the color reproductive capability of a computer display. As mentioned before, a computer display makes colors using red, green, and blue (RGB). Printers use cyan, magenta, yellow, and black (CMYK) to create a rainbow of colors. “... The first difference you will see when printing an RGB computer image to paper is a color shift, which is most often disappointing. The reason for this is simply that the computer and printer are struggling to make a three-color image into a four-color image.” This is the reason for needing a working color management system. If a printing company
has everything correct, the computer will be able to correctly communicate with the printer and make adjustments for the conversion from RGB to CMYK. That is just one step a company needs to take to start managing color properly.

There are many top professionals in the graphic communication industry who stress the importance of color management. Some experts from the American Industry Corporation (AIC) state, “integrating Color Management into your work flow is essential for obtaining better quality, increased productivity and reducing costs. It is valuable for everyone in any field making reproductions.” Those reasons alone prove that there are many benefits for having some type of color management system within any company. It can first increase color reproduction, which in turn will increase printed quality. If there is more consistency between the color seen on the proof and the color of the final product, the quality will increase. Color management will also reduce costs by eliminating waste. A customer will be able to detect if a company uses a system of color management or does not have a system of color management by the overall quality of the product. AIC also states that “color is the most immediately noticeable element of overall appearance, and the methods used to maintain color consistency between suppliers, products and individual parts are referred to as color management.” When a customer receives their product from a printer, the first thing they will analyze is the color quality of the print. If the color of the printed product is not what they expected, the customer will assume that it is of low quality. This is another reason given by the experts as to why color management is so essential to the graphic communication industry. “The importance of color has grown substantially since desktop publishing was introduced more than twenty years ago.” Color management has developed over the past twenty years and is continuing to grow. With technology constantly advancing, new color management work flows are being produced. However, it is important to understand why color management is changing and why marketing color is more important than black and white.

With the growth of color management, more and more people within the graphic communication industry are becoming interested in the subject. James Dempsey, a writer from Macworld.com, interviewed Andy Hatkoff, the Vice President of OEM, Original Equipment Manu-
facturer, and technology at Pantone. Pantone is the company that developed the color matching system that is world-renowned. Dempsey asked Hatkoff how color management has changed over the years. Hatkoff replied,

It’s become more accessible than it has in the past—it’s no longer the realm of just a few practitioners and color gurus, and you don’t have to spend thousands of dollars and have a degree in color science. Creatives of all types are now able to effectively manage color, whether designing for print, the Web, or even textiles. This explains why new color management technology is more readily available. Color management is easier for printing companies to obtain. There is no need to hire a color management specialist or to have very expensive equipment. Color management has shifted from the hands of color specialists, to anyone working in a creative environment or is just interested in the subject of color. The new workflow of color management had to be efficient and had to be easy to follow. Dempsey had then asked if there are still some problems with color management even though it has become more accessible. Hatkoff did not hesitate to answer yes. Hatkoff explained that people in the graphic communication industry still need to have general knowledge of color profiles and be able to choose the right workflow for the business. However, this is still easier to manage than before. Previous to new technology, the color management specialist of a printing business had to know the ins and outs of all the programs and how to use them. Now, anyone in the business can be taught information on the color profiles and the technology will provide the rest of the workflow. Right now, the biggest improvements in color management have been made to make it seem like color management is not even part of the workflow. Companies want it to work flawless and easily so that color management is effective for every job. However, Hatkoff reiterates that employees within a company still need to know when to properly apply color management and try not to get frustrated with it. No matter what new technology is used, there is so much information and importance in color management that some knowledge is needed for employees. Anyone in the graphic communication industry needs to understand the correlation of what is on a computer screen to what is actually printed. Color management in a way is still a science that needs to
be understood. Yet, new technology is helping close that gap between the difference on the screen and on print.

Companies in the graphic communication industry need to find what color management workflow works best for them and their equipment. There are some suggestions of where to start. Great Western Industries (GWI) is a leading company that provides items such as high-end cartons, plastics, and fine paper. GWI is proud of the fact that they provide a great color management workflow. They are so confident in their color management process that they guarantee customers 100 percent color satisfaction. An article from American Printer states that, “GWI’s color-management system is simple. It only requires purchasing the right technology, then training and empowering employees to manage and control each process. Training was an important factor in putting together a comprehensive-and effective-color-management workflow.” Making sure employees understand the connection between the computer and the printer is essential. Printing companies can buy all the technology they need, but if the company does not have the educated people to run that technology, there is no use buying it in the first place.

Experts in the industry say that if a printing company is having color issues, implementing a color management and quality control procedure to their specific workflow will help to solve these issues. This brings back ICC. The main purpose of ICC was to find a way to standardize color management. In doing so, ICC created what they now call ICC profiles:

An ICC profile is one that conforms to the ICC specification. By conforming to this specification profiles may be exchanged and correctly interpreted by other users. The two main types of profiles are source (input) and destination (output) profiles and essentially consist of tables of data that relate the device coordinates to those of the standard color space defined by ICC. There are various relationships defined in each profile. Special types of profiles (device link, and abstract) are defined for special workflow applications. As part of a color management procedure, a company can standardize their workflow. Custom ICC color profiles will help to eliminate some of the color differences from screen to printed product. Jacci Bear, the freelance graphic designer, restates how ICC profiles can help. “ICC pro-
files provide a way to insure consistent color. These files are specific to each device on your system and contain information about how that device produces color.” Once a company finds the right profiles for their equipment, the ICC profiles can be of great assistance to them. When used right, the profiles will help produce constant color from the computer to printer. However, ICC profiles are only the beginning of color management.

Another emerging technology that is helping with color management is virtual proofing. Hard proofing was the most widely used in the past. This means that actual prints were made to simulate the final product. Those proofs would then be given to whomever was in authority to either accept or reject the proof. This was a disadvantage for many reasons. First off, printing actual proofs are expensive. It takes time, money, paper, ink, and shipping costs for each proof. Shipping is the biggest downfall for hard proofing. Shipping costs can be extreme, especially is there is a cost associated for every proof made. This led to the invention of virtual proofing. “Color-accurate monitor proofing, more commonly known as virtual proofing, brings soft proofing to the next level. It implies a higher quality of color accuracy and similar expectations to that of any contract-quality hard proofing system.” Virtual proofing, in contrast to hard proofing, is all done from screen to screen. There is no need to print anything before the document is approved. The only way soft proofing can work, however, is if all the computer screens in use for color management are calibrated. In fact, soft proofing programs require that screens be calibrated before the proofing process begins.

This now focuses back on the graphic designers, the part of the color chain that has been left out of the process to a large degree. Graphic designers are the ones who create the original document, and those who should be calibrating their displays. It is up to them to design a good document for print right from the start. Graphic designers like Jacci Bear understand how color management is important to the final print production. However, most graphic designers don’t design for print; they design for what looks good on the computer display. This is one of the issues that color management is now facing. How can graphic designers get interested in the concept of color? What would make it easier for them to design for print? Some answers already exist.
The Apple iPhone and iPod Touch are two of the hottest new commodities for consumers. So to get even more people interested in color management, companies like Pantone have created applications for making color swatches from an iPhone. Now, anyone can have a color palette creation program on his or her portable handheld device. These applications are inspiring consumers to participate in the color business, and allowing them to participate in the graphic communication industry at a new level. One application offered is called Color Expert created by Code Line Communications. This application costs $9.99 and provides limitless opportunities. Color Expert allows customers to search through a color wheel, create their own swatches of color, manage CMYK colors, find the Pantone equivalent, and email those colors wherever needed. Color Expert understands that designers get their inspiration anywhere at anytime. So Color Expert allows designers to do so much with the everyday colors they see right from their phone. Color Expert was even named iPhone App of the Month in December 2008 by Mac Format Choice.

Similar to Color Expert is an application developed by Pantone. Pantone, Inc. is a subsidiary of X-Rite, the creator of the ColorMunki. MyPantone is an iPhone application that costs the same as Color Expert, but offers more features. For the purpose of this paper, the focus will be on the myPantone application:

With the MyPantone application, you have access to a variety of Pantone color libraries and the ability to build color palettes and share them with colleagues and clients. MyPantone offers graphic, web, fashion, and apparel designers. It features get your color inspiration and create your color scheme from these Pantone color system libraries, Pantone matching system, Pantone Go, Pantone pastels, you can capture and extract colors from photos and snap to the closest Pantone color, e-mail an HTML image of your palette, text and voice annotation of palettes, post notifications of new palettes to Twitter and Facebook, and GPS tagging of palettes. MyPantone is a new application that is allowing designers to access Pantone colors without having to carry around the usual heavy
books that all the Pantone shades usually come in. Not only that, but consumers can save all the colors on their phone and have the option to send the information on their computer. So if a designer needs a new color palette creation tool, but doesn’t want to spend a lot of money, he or she can just spend about ten dollars and get an application right on their phone.

*MyPantone* not only offers a color palette creation application on phones, but is also offers it on the Internet. Kuler, from Adobe Systems, is another example of a web site that offers color management tools. At Kuler.Adobe.com, one can do anything from creating a color palette to creating themes from an image at no charge. “Discover Adobe ‘Kuler’ — the web-hosted application for generating color themes that can inspire any project. No matter what you’re creating, with Kuler you can experiment quickly with color variations and browse thousands of themes from the Kuler community.” Many people have started to use this site to help with their design projects. These projects are not necessarily projects just for the graphic communication industry. Interior designers and general consumers use this site to generate an interesting color scheme for a project. Savitri Wilder, a Kuler member, comments on how Kuler allows her to try new color combinations quickly before she puts them into a scrapbook. The stories go on and on about how people are enjoying this web site for their color management needs. Kuler also offers a Kuler Desktop. This application allows members to organize their color themes on their computer desktop. The Adobe AIR also allows users to import their color palette into the Adobe Creative Suite with ease. However, if this is not enough, there is a different device that offers more color creation opportunities.

The ColorMunki is the new color measurement tool that this paper is going to focus on.
The ColorMunki offers the most to graphic designers at an affordable price. Calibration of computer displays is a key aspect to color management and the new trend of virtual proofing. Calibrating a display can ensure that the same colors on one computer display will be the same colors on another. This is a great tool that can help graphic designers make ease of designing a document for print. The ColorMunki is a spectrophotometer that helps make sure the colors you see on screen are accurate. The ColorMunki web site offered more information about the tool:

“PrintSafe’ verifies colors in the palette as in gamut or out of gamut for various paper stocks. You can preview palettes form CMYK or spot color printing, or use ColorMunki to predict how palette colors might reproduce in different print situations or under varying light conditions.”

The ColorMunki is a great tool used to guide in the creation of color management. What used to take hours and specially trained people to do is now a simple task. It is also cheaper than most computer software. The ColorMunki costs about $350.00. This is inexpensive compared to $2,500 - $3,500 used by printing companies for color management. But for the companies that have already implemented the ColorMunki, they are already feeling the benefits of spending a few hundred dollars. Mike Pasini, the editor of The Imaging Resource Digital Photography Newsletter, comments even further on the qualities of the ColorMunki. Pasini states:

Building a printer profile -- which is really a profile of a printer’s inks and a particular paper -- is not quite as easy. There are a lot of pitfalls that can invalidate the profile. But X-Rite provides a helping hand with video links on almost every page of the software, a call center to answer any questions you might have and an interactive, Flash-based, training video (available in six languages).And the rest is just gravy. Delicious, satisfying, lipsmacking gravy.

The ColorMunki can assist graphic designers to generate documents that are ready for print. This
new tool is just one of the few new innovative ideas that is allowing people to easily manage color where before it was only done by color specialists. Keith Cooper, a color management specialist and photographer, comments on this new tool developed by X-Rite. “What’s not quite so obvious for me is that a lot of people find color management really tricky … [ColorMunki] is aimed squarely at all those, who in the past, perhaps found the idea of color management just a bit too much.” This new wave of technology is aimed at the people who were not considered to be color managers. Now more and more people within the graphic communication industry are excited and motivated to create color palettes.

The software that comes with the ColorMunki device is very intuitive. As mentioned before, the program is very straightforward with instructions. The software has pictures and diagrams that follow what the user is doing. It also pops up with step by step instructions on how to calibrate the ColorMunki and the computer display. On top of calibrating displays and creating color profiles, the ColorMunki can automatically extract colors from a photo. When ColorMunki opens, it links with iPhoto. Any picture in the iPhoto gallery can be selected, and within seconds, a color palette will be created using the colors from the picture. Or, a color palette can be created using the actual ColorMunki device. When the ColorMunki is plugged into a USB drive, it will automatically ask to be calibrated to its own white spot it already has programmed. Once that is done, anything can be sampled. For instance, say a graphic designer was designing a logo for a local orange grower. The graphic designer can take a real orange and take a color sample of it from the ColorMunki. The ColorMunki will create a new color palette with that orange color sampled. On the right hand side, the
complementary color, triadic colors, split complement colors, analogous colors, and monochromatic colors all appear. At this point, the graphic designer can use any of those colors to create a logo with appropriate colors. It also will give the value of sRGB and CIELab color (CIELab color to be discussed later). If the designer has a printer profile already provided, he or she can then snap the orange color to that profile. ColorMunki will show how the color will look printed. This also works for snapping colors to standard color profiles and Pantone colors. Once the palette is created, the graphic designer can export the colors into any of the programs in the Adobe Creative Suite. Then, magically, the designer is ready to create a logo with the color of a real orange. The ColorMunki can be useful in so many ways to so many people.
CHAPTER III: RESEARCH METHODS

In the printing industry, color management concerns not only the people in the industry, but also consumers. Color is the first item that a consumer will see when they look at a print. Color is also now a concern for all types of consumers and designers. Managing color is now easier and more exciting than ever before. Through descriptive data, elite and specialized interviews, and content analysis, I will show that color is now manageable by people of all sorts, specifically graphic designers. It will also answer whether or not people in the industry are accepting of new technologies. The research will be focused on the ColorMunki. By giving some graphic designers hands on experience with the ColorMunki, it can be determined whether the ColorMunki provides benefits. After the test run with the graphic designers is completed, an interview will be given in order to establish what their experience was like. To further the research on the ColorMunki, content analysis will be conducted to compare the measurements between the ColorMunki and a more expensive color management tool. The conclusion of all the research will focus on whether or not the new technologies, such as the ColorMunki, provide suitable color management tools that anyone can use.

Surveys are one way to collect descriptive data. Descriptive data is a way in which you search for facts that have happened in the past and then draw conclusions about them. Dr. Harvey Levenson, in his book *Some Ideas About Doing Research in Graphic Communication*, states that data, such as a survey, can help provide evidence of changes that may determine the future. Surveys can reveal information about the topic being researched. Surveys are also a great way to provide information of what is currently true in the graphic communication industry. In the case of color management, the survey will provide information on whether or not the ColorMunki is a viable color management tool for graphic designers to use. The survey will be given to two local graphic designers in San Luis Obispo. The first graphic designer is Wyatt Renew, the art director and resident digital DJ at iiiDesign. The second graphic designer is Ashala Lawler, who has been an independent designer in San Luis Obispo since the 1970s. In 1991, she started her own home-based graphic design business. They will be provided with the device and software needed to run
the ColorMunki. Renew and Lawler will have a week to use the ColorMunki. The point is for the graphic designers to write down their thoughts as they use the ColorMunki. A questionnaire will be given to them asking them to list what they like and dislike about the ColorMunki. This way, there will be an overall view of how the graphic designers felt about the new technology and how comfortable they felt managing color on their own.

The questions will be open ended so that the responses can be as detailed as they want them to be. This way, a holistic look at the ColorMunki features can be concluded. A common theme can also be made from the responses that both Renew and Lawler gave.

To make sense of all the data collected from the survey, content analysis will then be conducted. Content analysis is the way in which results are gathered and analyzed and put into a visual representation (Levenson). The information from the survey will be organized in a chart. The answers they gave to the positive and negative aspects will be put in bullet point form. Column A will be the main points the graphic designers liked about the ColorMunki. Column B will be the main points the graphic designers did not like about the ColorMunki. Totals will then be given at the end for the likes and dislikes. Once this is done, a conclusion can be made on the overall effectiveness of the ColorMunki.

Once the graphic designers have had adequate time to draw conclusions about the ColorMunki, an elite and specialized interview will be given. The purpose of this type of interview is to gather different responses researched before. The interview is to be conducted as more of a conversation, not a formal interview. The interviewer and interviewee must come together during the process as a team working for a common goal (Levenson). The intent of the interview is to get an inside look at what the graphic designers overall feelings about the ColorMunki are. This going beyond just listing the positive and negative aspects of the ColorMunki, it will express as a whole how they felt about the new device as they designed using the ColorMunki.

I was able to sit down with Wyatt and talk with him in person and get more details on what he experienced with the ColorMunki. I was unfortunately not able to sit down in person with Ashala due to busy schedules. However, I was able to gather her final conclusions via email.
By interviewing these two graphic designers, the goal is to find the common thread between the two. This will show what were the most important factors that stood out. Again, since I already got a list of likes and dislikes from the survey, I wanted to gather even more detail about their experience with the ColorMunki.

Content analysis will again help gather the data from the elite and specialized interviews into a cohesive final observation. This will lead to a great conclusion of whether or not the graphic designers would use the ColorMunki again on a daily basis. The data will be gathered in a grid format. Comments from the graphic designers will be organized into 3 columns. The first column will be positive comments, the second will be for neutral comments, and the third will be for negative comments. Each comment will be given a “+1” if it a positive response, neutral will be given a “0”, and a negative response will be given a “-1”. All the scores will then be added in the end giving the ColorMunki an overall score. When looking at the grid, it will be easy to see if the responses given by the graphic designers correlate with the perceived value of the ColorMunki. For the purpose of this study, it is also vital that a test be made to compare the ColorMunki with other similar devices available to the graphic communication industry. There are more expensive devices available that have similar features to the ColorMunki. An example of another device would be the i1Pro (pronounced eye one pro). Coincidently, x-rite makes both the i1Pro and the ColorMunki. The i1Pro offers similar features that the ColorMunki does, but costs a great deal more, almost $1,000 more. With the i1Pro, “you’ll easily be able to measure, mix and share spot and PANTONE® colors plus measure and evaluate flash and ambient light, and color temperature of light booths!” Since these two devices offer the same services, they can easily be compared.

There is only one other main difference between the ColorMunki and the i1Pro. The software that comes with the ColorMunki can be installed on any number of computers with the one CD given. However, the i1Pro requires that you buy a special software chip in order to run the device. The point of this would be to see how accurately the ColorMunki measures color compared to the more expensive device.

In order to gather data, color measurements will be taken from both devices. Since both
the ColorMunki and the i1Pro both use Pantone colors, the ten primary Pantone colors will be measured. A white piece of paper will be placed underneath the Pantone book so the environment will be consistent. Two readings of the same color will be made from one device, then averaged out. The readings will be made in the CIELab color space. The Lab color space is one in which the i1Pro and the ColorMunki reads. The reason for this is because the CIELab is a three dimensional color space that is the best representation of what the human can see. The L stands for luminance, meaning it measures lightness of a color. If L=0, it means the color is black. If L=100, it indicated a white color. A measures the difference between red and green. A negative number in A represents a green color while a positive number represents red. Similarly, B represents yellow and blue. Positive B indicates yellow, while negative values are blue. After the 10 measurements are taken from both devices, a ΔE equation will be conducted. This will calculate the difference in the color measurements made by the ColorMunki and the i1Pro.

It will be easier to see the color differences visually. Once the LAB color space numbers are calculated, a visual representation can be made. For each of the primary Pantone colors, a color swatch will placed next to each other from each device. The purpose of this is to show what differences in color measurements were made from the ColorMunki and the i1Pro.
CHAPTER IV: RESULTS

The graphic designers gave great feedback through surveys, interviews, and content analysis. Wyatt Renew and Ashala Lawler both used the ColorMunki for a week and concluded final thoughts about the ColorMunki. The surveys gave an insight as to if the graphic designers in general liked the ColorMunki. The interviews gave more detailed descriptions about the ColorMunki’s positive and negative qualities. Last but not least, the data collected from the ColorMunki and the i1Pro gave great insight as to how accurate the ColorMunki measures color. Overall, the research conducted presented details on how two people in the graphic communication industry perceive the ColorMunki.

The survey “What Are Your Thoughts About the ColorMunki?” established the main positive and negative qualities about the ColorMunki. When you look at the chart, it is clear to see what both Renew and Lawler thought about the ColorMunki. Both the graphic designers commented on how easy the ColorMunki was to use. Neither had any questions on how to use the device. All the prompts given in the software was straightforward and made sense to them. The compatibility with the Adobe Suite was also a bonus for the graphic designers. Renew and Lawler both use Adobe Creative Suite programs on a regular basis for design projects. The fact that the ColorMunki could easily create color swatches in any program was a plus for both of them. It was also easy for both of them to take color samples from anything they needed. The last com-

<table>
<thead>
<tr>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Easy to use</td>
<td>• Can't pull samples yourself from photos</td>
</tr>
<tr>
<td>• Compatible with Adobe suite</td>
<td>• Scanning for printer profile takes a long time</td>
</tr>
<tr>
<td>• Great instructions</td>
<td>• Colors not always accurate from screen to print</td>
</tr>
<tr>
<td>• Swatch creation fast</td>
<td></td>
</tr>
<tr>
<td>• Overall clear instructions</td>
<td></td>
</tr>
<tr>
<td>• Affordable</td>
<td></td>
</tr>
<tr>
<td>• Reminders to calibrate screen</td>
<td></td>
</tr>
<tr>
<td><strong>Total: 7</strong></td>
<td><strong>Total: 3</strong></td>
</tr>
</tbody>
</table>
mon comment made by both designers is the ease of calibrating their computer screen. Both had mentioned they didn’t have an easy way to do it before and appreciated the fact that ColorMunki offered a calibration method.

While the ColorMunki seemed to impress both Wyatt Renew and Ashala Lawler, there were some negative comments. The ColorMunki can automatically extract, but it won’t let the user chose their own. Renew said it would be nice to have the choice to do that himself. He felt as if it would have been nice to be able to take color samples from a photo like in Adobe Photoshop.

<table>
<thead>
<tr>
<th>Positive (+1)</th>
<th>Neutral (0)</th>
<th>Negative (-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Calibration very easy</td>
<td>• Extracting colors from iPhoto automatically is nice but would like to</td>
<td>• Ambient light seemed off</td>
</tr>
<tr>
<td>• Spot scanning was easy</td>
<td>also have to choose to do it manually</td>
<td>• ColorMunki has a hard time scanning color bars</td>
</tr>
<tr>
<td>• ColorMunki overall intuitive</td>
<td>• Lighting and proofing combinations might help choose appropriate colors</td>
<td>• Blues don’t come out accurately from screen to print</td>
</tr>
<tr>
<td>• Color collections easy</td>
<td>for newspaper ads</td>
<td></td>
</tr>
<tr>
<td>• Simple to create swatches in Adobe Suite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Software easier to understand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Exporting color swatches simple</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Easy to profile display on regular basis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Can easily create palettes for different design jobs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Colors logically named</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Can import many color palette types into ColorMunki</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Yellows and oranges very accurate from screen to print</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total: 12</td>
<td>Total: 0</td>
<td>Total: -3</td>
</tr>
</tbody>
</table>

The ColorMunki also took a long time for Renew to profile a printer. He said it took a long time to scan the color bars manually with the device. He also tried to print out some projects he made with the measurements taken from the ColorMunki and saw a noticeable difference in color from his computer display to the print. However, the graphic designers had more positive comments about the ColorMunki than the negative. When looking at the table, one can see that there are significantly more positive points than negative points. Wyatt Renew and Ashala Lawler together had similar likes about the ColorMunki. Ashala Lawler did not focus on the negative aspects, but Wyatt did come up with 3 general aspects of the ColorMunki that he did not particularly like. With this said, it can be concluded that the two graphic designers did like the ColorMunki for what it is made to do. They both had an easy time using the device and really liked how easy it was to create a palette and import it into the Adobe Creative Suite.

The elite and specialized interview gave even more insight as to how the graphic designers used the ColorMunki to aid their current projects. Both Renew and Lawler started using the ColorMunki by calibrating their computer displays. This was a positive aspect for both of
them. Renew stated that the calibration was an “easy process, not too long, and had clear instructions”. Ashala Lawler mentioned how she liked the calibration. She said, “I love that I can easily profile my display on a regular basis. This was always something I had to have someone else do for me and I hated that I didn’t understand how to do it myself.” Both graphic designers already expressed a liking for the ColorMunki with just being able to properly calibrate their computer displays. Yet, there was more for them to explore, and both Renew and Lawler continued to be impressed with this new color management technology. As mentioned before, Renew and Lawler both had similar positive comments about the ColorMunki, but drew those conclusions in different ways. Lawler took a picture from one of her projects and created a color palette using the ColorMunki. Renew used the Firestone Beer label as a project to use with the ColorMunki. Interestingly, both Lawler and Renew seemed to have the same list of advantages as they went about designing their projects.

Ashala Lawler has been designing the San Luis Obispo Chamber of Commerce’s Visitors’ Guide for the past 12 years. The Visitors’ Guide consists of “a 68-page color publication that incorporates lavish editorial photos with copy and advertising.” She said:

I imported a photo used in last year’s Visitors’ Guide into ColorMunki and created a palette. Then I placed the photo and imported the palette into InDesign. My thought is that for next year’s guide, each page or spread will have its own palette created from the pictures used on those pages. In the past I’ve created one palette for the whole project before choosing the images, and surprising it has worked. I’m very excited to see how this new technique will work.

Lawler liked the fact it was so easy for her to extract the colors automatically out of the picture and import them right into InDesign. The photo shows the picture and the colors selected from the ColorMunki.
The ColorMunki gave her a new way to create a theme and color palette for next year’s guide.

Wyatt Renew has been working on designing the Firestone Beer labels. The colors on the Firestone Beer labels range from a dark blue to a warm yellow. The image of the Firestone Beer truck from the iiiiDesign web site is a great representation of the colors Renew was working with. Renew had been using Pantone colors given to him to make sure that the Firestone label colors were consistent from designer to designer and to print. By using the ColorMunki, Renew could take spot colors from the printed labels that were already placed on the bottle.

This is where he commented that spot scanning was very simple to do. After scanning in some colors from the printed labels, he printed the colors out again from the ColorMunki program to see how close the colors looked when printed. The results came back positive for two colors and negative for one color. Yellow and orange colors were accurate from the screen to print. Once the yellow and orange labels were printed out, using the colors measure by the ColorMunki, he compared them with the already printed labels. Renew stated that these colors were “right on.” He didn’t have to work with any Pantone colors. He simply measured the colors from a sample and used those colors through the whole design process. While it worked for the yellow and orange color range, Renew was not impressed with the blue quality. He took the same steps as before, but when he printed out the blue, it was visibly a different shade of blue.

Once all the comments from both graphic designers were put into a chart, it was clear to see what the overall rating for the ColorMunki is. There were a total of 12 positive comments, giving the total of 12 points. There were 2 neutral comments, which equal out to zero. Lastly, there were 3 negative comments giving the ColorMunki -3 points. Once all those scores were added, the ColorMunki gets an overall rating of 9. The ColorMunki was liked by both Renew and Lawler. Considering that after every comment they made, the score still came out a positive num-
ber was a great sign. After this was all said and done, Renew only had one last concern. Renew said the ColorMunki “is so simple that it doesn't seem technical and reassuring.” Since the ColorMunki is so easy to use and does everything at a fast pace, Renew started to question the quality of the software. Was the ColorMunki as accurate as other, more expensive devices? This is why it was so important to compare the ColorMunki with the i1Pro.

A comparison was made between the color measurements from the ColorMunki and the i1Pro. The 10 primary Pantone Goe colors that were measured are:

- Medium Yellow
- Bright Orange
- Bright Red
- Strong Red
- Pink
- Medium Purple
- Dark Blue
- Medium Blue
- Bright Green
- Black

For each color, two measurements were taken from each device then averaged out. As mentioned before, these colors are measured in the CIELab color space. There will be an average measurement for the L, a, and b separately for each device. Once the averages for the CIELab space were calculated, the difference between the two numbers were found. The results for each color were different and provided a conclusion about the consistency of the ColorMunki compared to the i1Pro.

The following chart shows all the measurements taken for each color.
Please note: $\Delta E$ represents the difference measured between the ColorMunki and the i1Pro. A

<table>
<thead>
<tr>
<th></th>
<th>ColorMunki</th>
<th></th>
<th>i1Pro</th>
<th></th>
<th>ΔE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>a</td>
<td>b</td>
<td>L</td>
<td>a</td>
</tr>
<tr>
<td>Medium Yellow</td>
<td>87.9</td>
<td>-0.1</td>
<td>110.8</td>
<td>87.2</td>
<td>-0.25</td>
</tr>
<tr>
<td>Bright Orange</td>
<td>63.6</td>
<td>61.2</td>
<td>92</td>
<td>62.8</td>
<td>60.7</td>
</tr>
<tr>
<td>Bright Red</td>
<td>57.1</td>
<td>72.2</td>
<td>56.4</td>
<td>55.9</td>
<td>71.9</td>
</tr>
<tr>
<td>Strong Red</td>
<td>43.4</td>
<td>78.9</td>
<td>14.4</td>
<td>42.7</td>
<td>78.2</td>
</tr>
<tr>
<td>Pink</td>
<td>51.3</td>
<td>70.1</td>
<td>-15.4</td>
<td>50.6</td>
<td>70.7</td>
</tr>
<tr>
<td>Medium Purple</td>
<td>20.2</td>
<td>49.7</td>
<td>-58.5</td>
<td>20.1</td>
<td>50.8</td>
</tr>
<tr>
<td>Dark Blue</td>
<td>20.9</td>
<td>26.9</td>
<td>-66</td>
<td>21.1</td>
<td>26.7</td>
</tr>
<tr>
<td>Medium Blue</td>
<td>47.8</td>
<td>-33.9</td>
<td>-53.2</td>
<td>48.2</td>
<td>-34.8</td>
</tr>
<tr>
<td>Bright Green</td>
<td>59.2</td>
<td>-73.9</td>
<td>1.1</td>
<td>59.7</td>
<td>-74.65</td>
</tr>
<tr>
<td>Black</td>
<td>9.9</td>
<td>0.6</td>
<td>0.9</td>
<td>10.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

10 would be a very unacceptable color difference, while a score of up to 5 is generally accepted.

When looking at the $\Delta E$ numbers, it can be concluded that the ColorMunki was never that far off from the measurements taken by the i1pro. The smallest difference was a $\Delta E$ of 0.6 in the bright green color. The largest difference was seen in the medium purple range, which had a $\Delta E$ of 3.4.

It is also interesting to compare these number to what Wyatt Renew had mentioned earlier about the color differences between the screen and print. Renew had mentioned that the yellows and oranges seemed to measure perfectly, while the blues had no consistent print. When looking at this chart, it is the orange, reds, and purples that had the biggest difference. The color measurement difference on the blues and green were very minute compared to the other colors.

The following is a visual representation of the color differences. The Pantone color on the left is the primary color measured out of the Pantone Guide/Coated.
• Medium Yellow: $\Delta E 1.7$

Pantone  |  ColorMunki  |  i1Pro

The i1Pro is slightly darker than the ColorMunki, while the ColorMunki seems a little lighter than the Pantone.

• Bright Orange: $\Delta E 3.1$

Pantone  |  ColorMunki  |  i1Pro

The Pantone and the i1Pro have a closer measurement than compared to the ColorMunki.

• Bright Red: $\Delta E 3.4$

Pantone  |  ColorMunki  |  i1Pro

The ColorMunki was a little more orange than the Pantone, but still very close to the i1Pro.

• Strong Red: $\Delta E 1.5$

Pantone  |  ColorMunki  |  i1Pro

There is a noticeable difference here. The ColorMunki and i1Pro had a large gap in the b value.

• Pink: $\Delta E 0.8$

Pantone  |  ColorMunki  |  i1Pro

The pink is similar across all three of the colors. Only a slight difference between the ColorMunki and the i1Pro.
• Medium Purple: ΔE 3.4

It is hard to the eye to see the difference in these colors. Again, the largest gap was in the b value.

• Dark Blue: ΔE 0.7

With only a ΔE 0.7, it is hard to tell the difference here. The Pantone is just slightly darker than the ColorMunki.

• Medium Blue: ΔE 0.9

Again, only a small change between the three colors. The ColorMunki and the i1Pro appear the alike.

• Bright Green: ΔE 0.6

The biggest change here was in the a value, meaning that the i1Pro is a little more green than the ColorMunki.

• Black: ΔE 0.7

The ColorMunki looks identical to the Pantone black, while the i1Pro seems to be lighter.
Now that all three colors are visible to the eye, one can see that for the most part, the ColorMunki does in fact produce adequate measurements. The average ΔE between all the 10 Pantone Geo colors was ΔE of 1.7. This is a very small difference. The eye can see a major color difference at ΔE 10. The conclusion is that the ColorMunki never reached above ΔE 2 compared with the i1Pro.
CHAPTER V: CONCLUSIONS

Throughout this study it has become clear how color management has evolved over the years. There has been so much focus put on managing color in the production process in the past. The graphic communication industry has now seen a shift in color management specialists to color management generalists, thanks to the new color management tools. There is no doubt that managing color will always be an important factor in the graphic communication field. Many standards have been created to try to streamline the process of color management from design to print. However, those standards could still be hard to implement and understand. Now, all that confusion has been taken out in new devices leaving graphic designers with an easier way to manage color.

The development of iPhone applications and web sites have given a new face to color management. MyPantone has given color management to that hands of any iPhone user. No matter where people are, one can take a picture and instantly create a palette from there. The Internet has a wide variety of web sites that allow people to create and manage color swatches for free. Between the iPhone applications and color web sites, a new color management revolution is evolving. Not only are graphic designers using these products, but everyday consumers are. The graphic designers can have even more color power through the ColorMunki.

By giving the ColorMunki to two graphic designers, a final statement about the quality of the ColorMunki can be made. The survey showed that while there were a few common negative comments about the ColorMunki, the graphic designers liked the ColorMunki more than they disliked. Ashala Lawler and Wyatt Renew both agreed that the ColorMunki was easy to use and had great direction. Lawler and Renew were able to achieve what they wanted using the ColorMunki. They especially liked the fact that the ColorMunki software was compatible with the entire Adobe Suite.

Wyatt Renew used the ColorMunki to help provide him with more accurate color for the Firestone labels he had been designing. He commented on how he liked how fast the ColorMunki took the samples and imported them into the software. While the yellow and orange colors re-
produced on print perfectly, the blues did not. Renew was a little disappointed in this along with one particular feature. While it is nice that the ColorMunki extracts colors from photographs automatically, Renew stated it would be nice to have the option to choose the colors on his own. Despite that, Renew found the ColorMunki to be very perceptive and helpful.

Ashala Lawler used the ColorMunki to help aid her in selecting colors for the San Luis Obispo Visitors Guide. Instead of picking out colors one by one, she could take a photograph and get all the colors right away. Lawler also mentioned how it would be nice to easily select different colors for the different ads. One big advantage for her was being able to calibrate her screen within a few minutes. What was once a chore for her was now simple thanks to the ColorMunki. After collecting both Lawler and Renews comments, there was a unanimous liking for the ColorMunki.

Some would be a little skeptical of the ColorMunki because of its price and its ease of use. However, when compared to the more expensive and more complicated i1Pro, it seemed that the ColorMunki was never that far off. The measurements helped show that the ColorMunki does take adequate color measurements that can be used for graphic design projects. The difference in color measurements between the ColorMunki and the i1Pro never reached above 3.4. Looking at the color swatches shows that the differences are very minute and in most cases acceptable results.

These new color management technologies, like the ColorMunki, are very exciting. They are opening up new windows and opportunities for people in and out of the graphic communication industry. It does not matter what industry you are in, color management is an important concept. Now that there are tools that help with managing color, there is no reason for a company not to use them. Even with the economy the way it is today, there are affordable solutions for everyone with any color need.
REFERENCES


MyPantone. iTunes application.


*Note: Ashala Lawler was recommended to me by my advisor Brian Lawler because of her professional work in design and color publications. The transactions with Ashala did not involve Brian. All conversations and emails only involved Ashala and I.