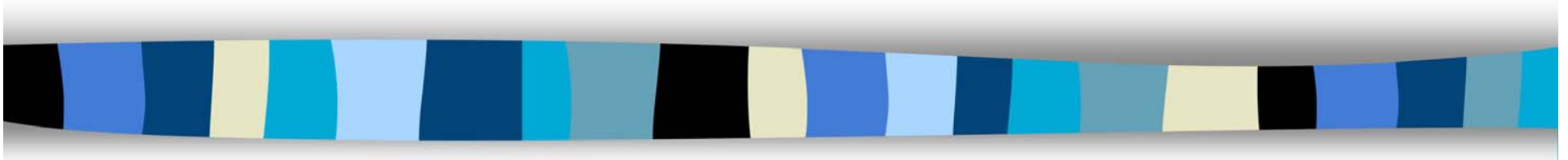


New Trends in Color

Dr. E. M. Granger



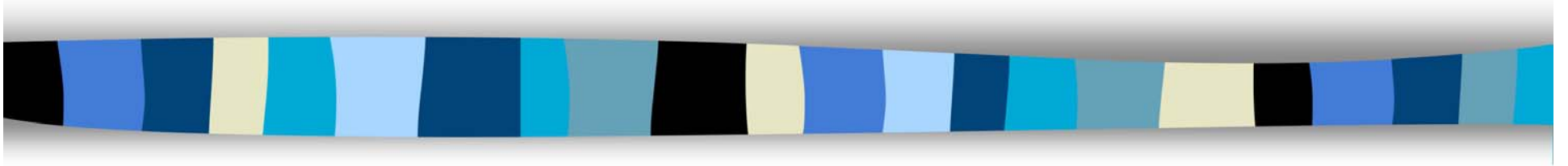
Something *Old*

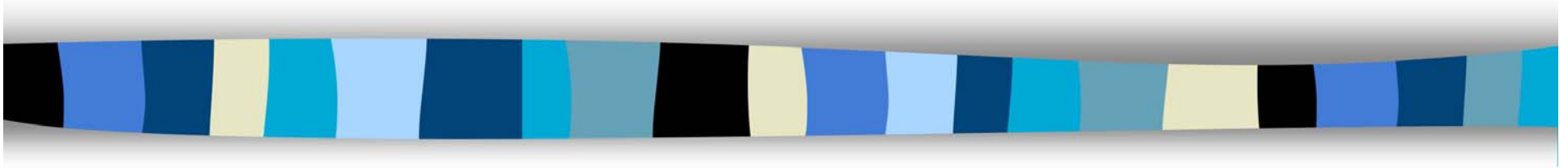
Something **New**

Something **Borrowed**

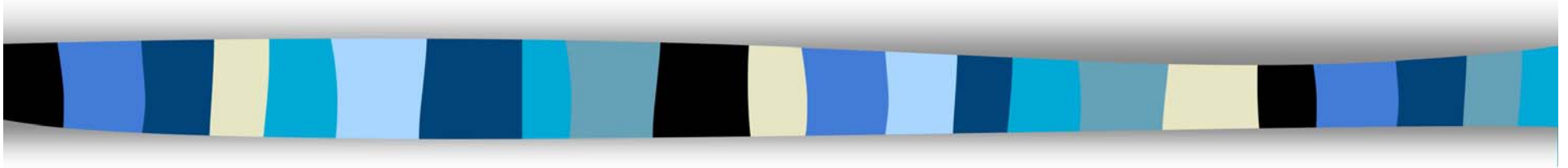
Something **BLUE**

What if I were to tell you...

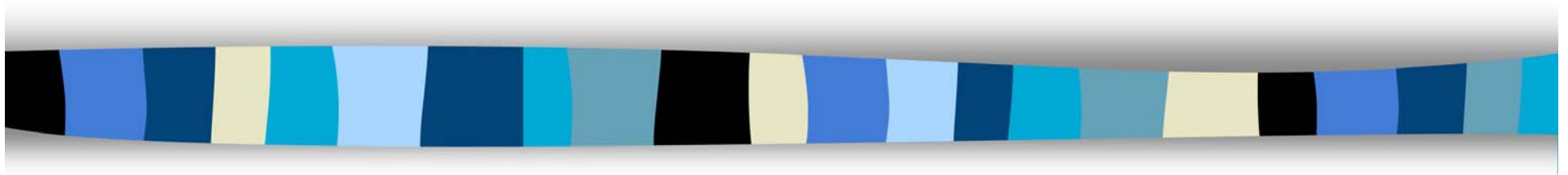




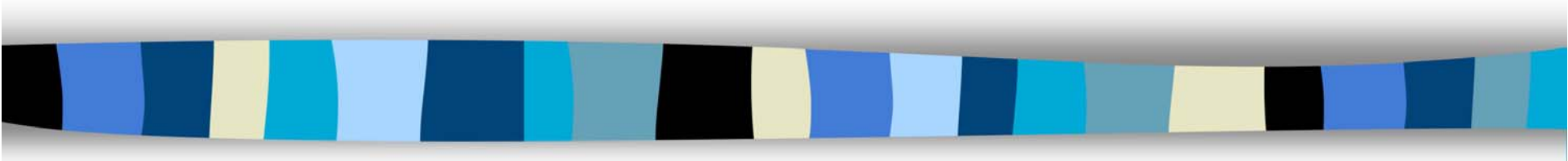
...it's possible to do more accurate
color management with less hassle,
giving better color?



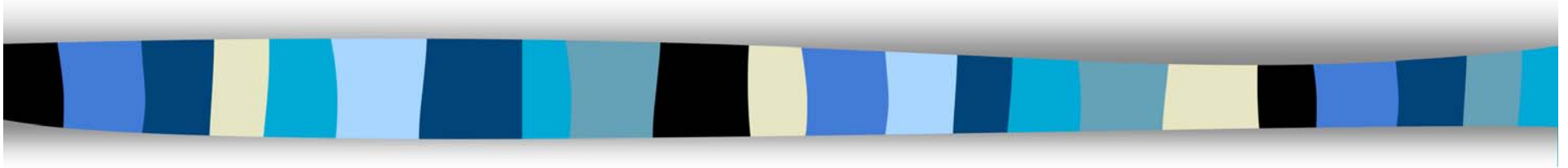
...you can pull out of your presses
a wider range of colors than
you've ever seen before?



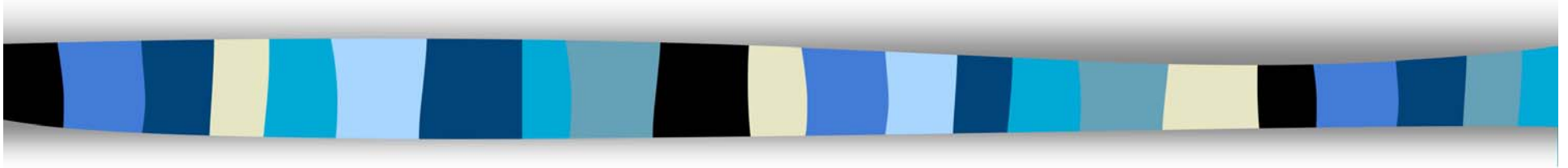
...you could easily print with white ink,
on colored paper,
yielding gorgeous full color prints?
(without printing a white block first?)



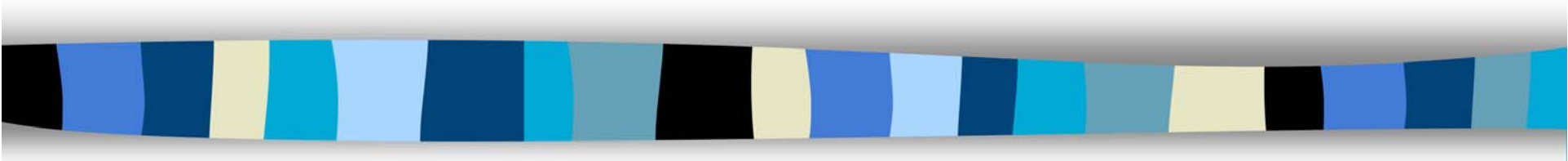
...ANY number/combination of inks can be color managed, easily and very accurately?



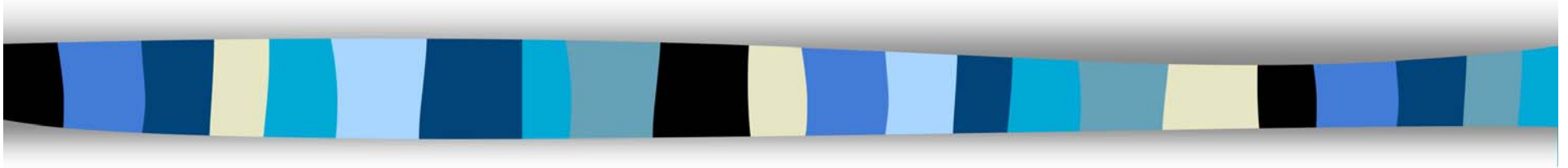
...you can factor in and correct for
the color cast of the paper in printing
neutral greys?



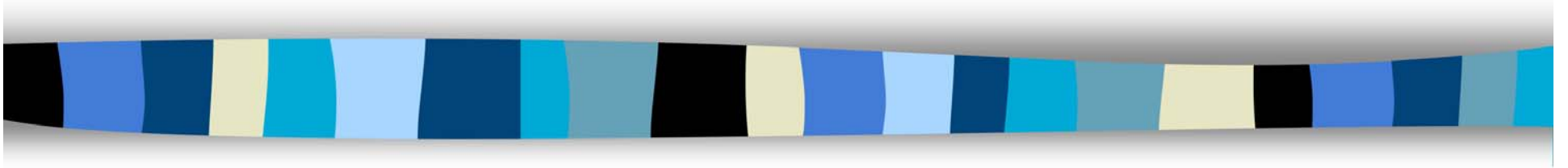
...makeready can be both faster
and more precise?



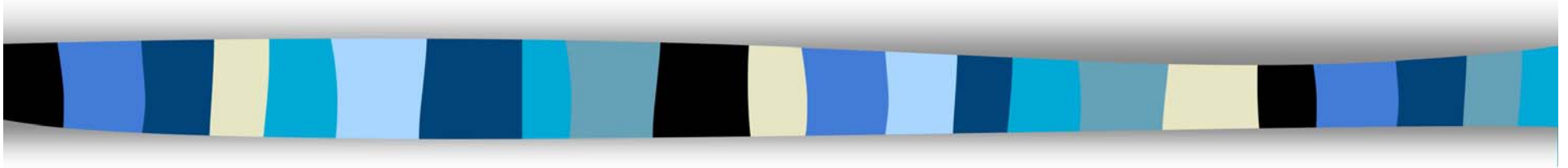
...you can have almost magical
improvement printing pastel tones,
yielding spectacular resolution and fidelity?



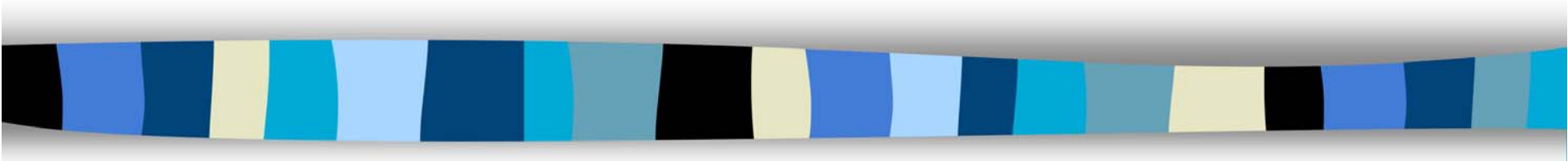
...color casts in neutral greys can
be a thing of the past?
(even on colored papers?)



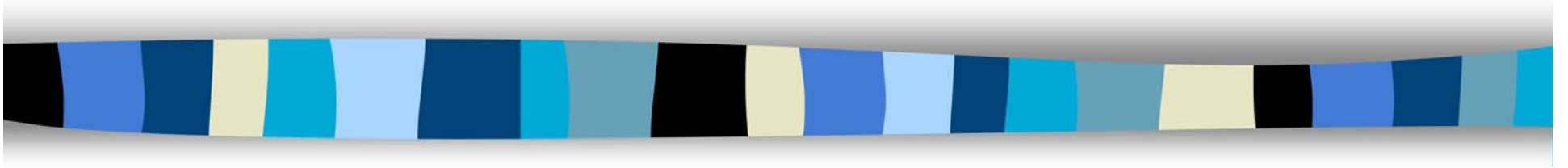
...High Key, Low Key, Wide Range
Chromatic, Duotones, Quadtones
—no matter what the image...



...it prints better than ever,
giving you (and your customer)...



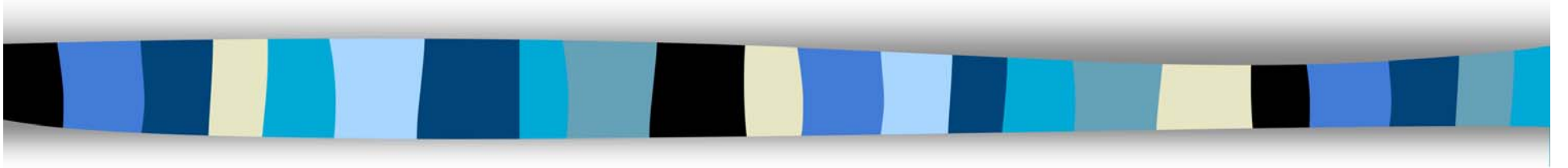
...speedier turnaround, reduced costs,
increased use of existing assets,
improved customer satisfaction, and
reduced frustration...



...giving us more of everyone's
favorite color...



Green!



You can.



THE MARRIAGE

- Graphic arts and electronic imaging
- Promised dowry
- Expectation of family and friends
- What is missing?
- Can the marriage be saved?



THE DOWRY

- Device Independence
- Uniform Color Space
- Profile Connection Space (PCS)
- Profiles - ATOB - BTOA
- Simplified Workflow



FAMILY and FRIENDS

- 25 K High-End Printers
- 15 M Enterprise Users
- 250 M Users of Windows, Mac OS, UNIX



EXPECTATIONS

■ High - End Printers

- Composited and page ready CMYK files sent to color managed printer
- Proofs and printed pages match

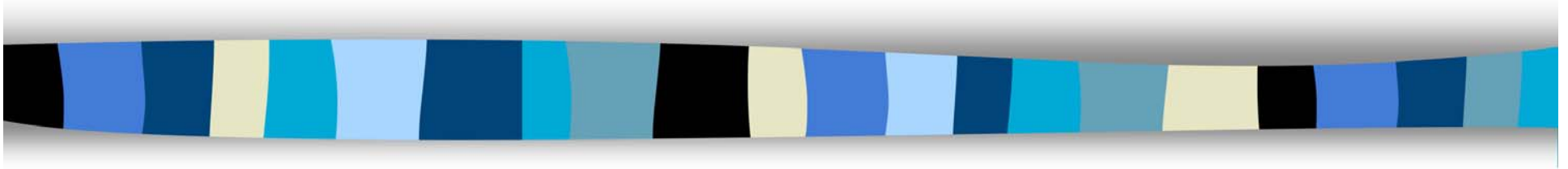
■ Enterprise

- Documents received from the reproduction center match the screen originals

■ Windows and Mac Users

- Printed images match the screen

Was this marriage made in heaven?

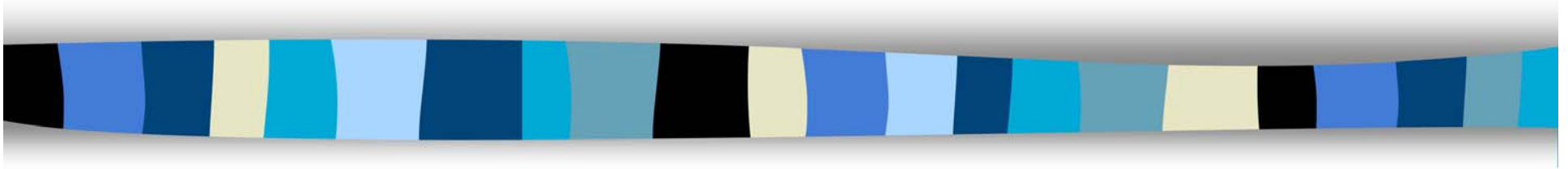




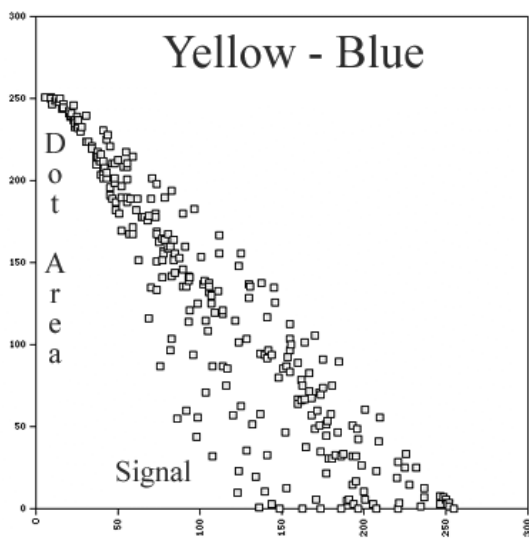
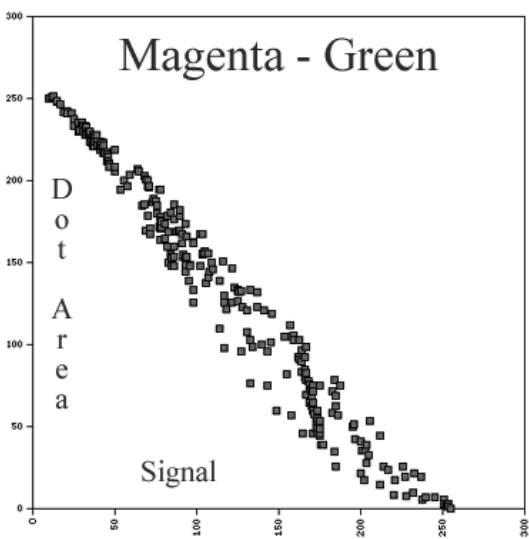
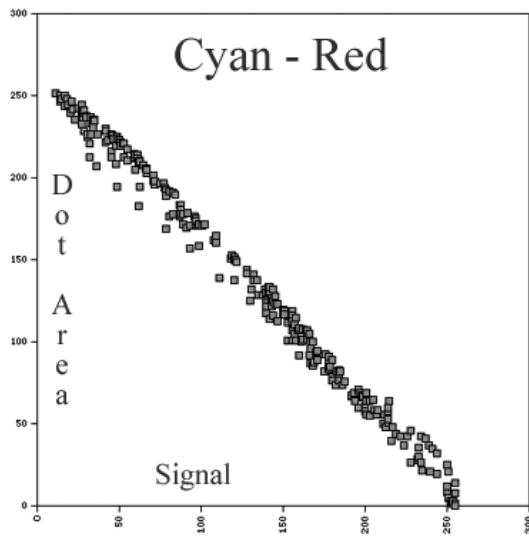
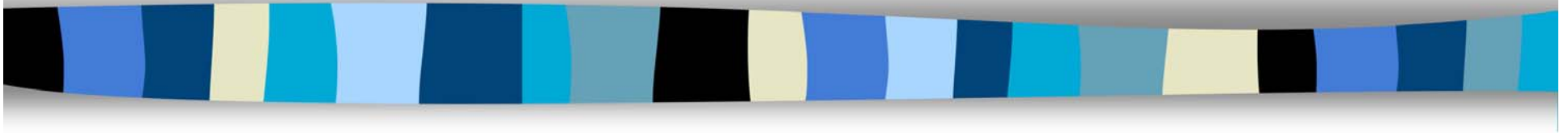
SITUATION TODAY

- Apply a Stimulus and Measure the response
- Convert the Response to XYZ or L*a*b*
- Sample a Colorimetric Volume
- Create 3-D Profile in Equal Appearance Steps

WHAT IS MISSING ?



RGB - CMY Linearity



ATOB - BTOA TRANSFORMATION

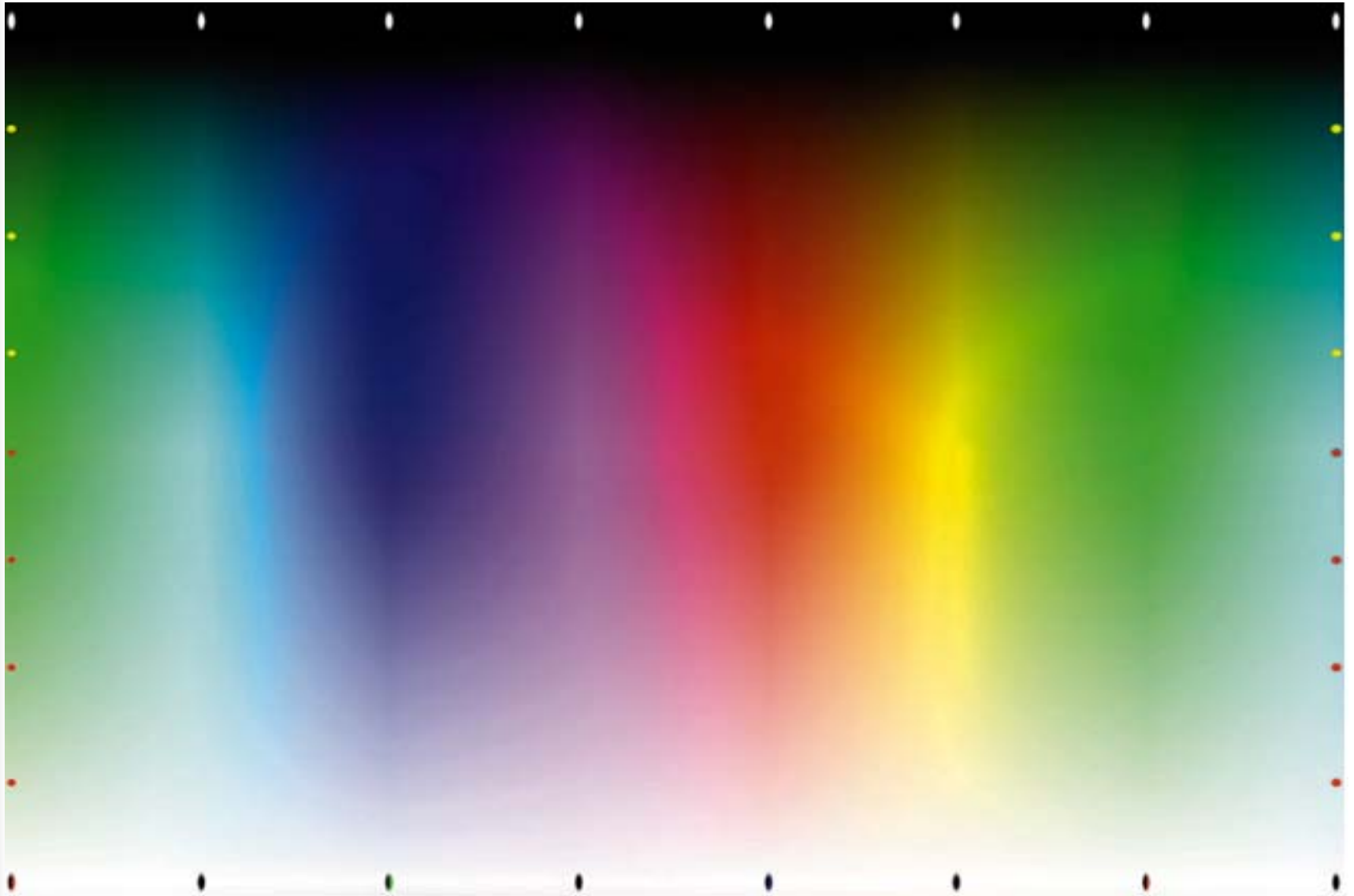


Image Key





RESTORING HAPPINESS

■ An Automobile Example

– Automatic Transmissions before 1988

- Fluids in Channels
- Pressure Sensitive Valves
- Complex interconnection of valve timing and shift points
- Performance and smoothness of shift was a compromise



RESTORING HAPPINESS

■ An Automobile Example

- Ford 1989 -Computer controlled transmission
 - Measure speed, airflow, temperature, torque load
 - This works because of the independent inputs to a Computer model of the Engine
 - Optimum rather than compromise solution produces better performance and gas mileage



RESTORING HAPPINESS

- **SO WHY NOT COLOR DEVICES**
 - Need spectral characterization
 - Better models of device spectral operation
 - Device updating is independent of the system
 - Documents do not carry profiles
 - Device profiles are local to the device



SOMETHING OLD

- Gamut mapping is achieved by adjustment of dot tone scale



NATURAL ADAPTATION

$$S = \frac{K_1 * N}{(K + N)}$$

Is a model of the saturation
that occurs in the visual system
where N is the number of photons
falling on the retina and
S is the adapted visual signal.

Adaptation Example



Original



Low Covering
Power



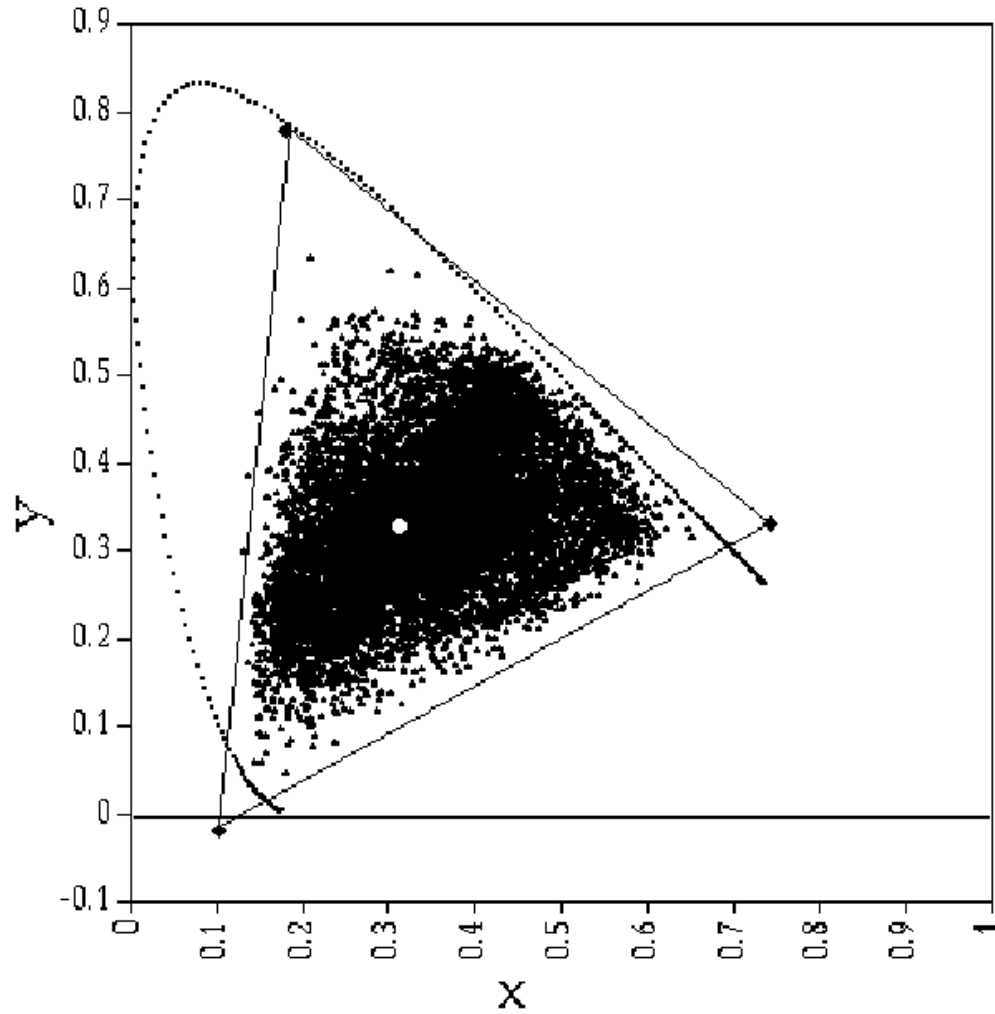
Low Covering
Power Plus
Adaptation



SOMETHING NEW

- Metric RGB Space
- ATD Color Space
 - Integer math
 - Linear chromaticity space
 - Approximates munsell color space for the range of illumination used in printing

mRGB PRIMARIES





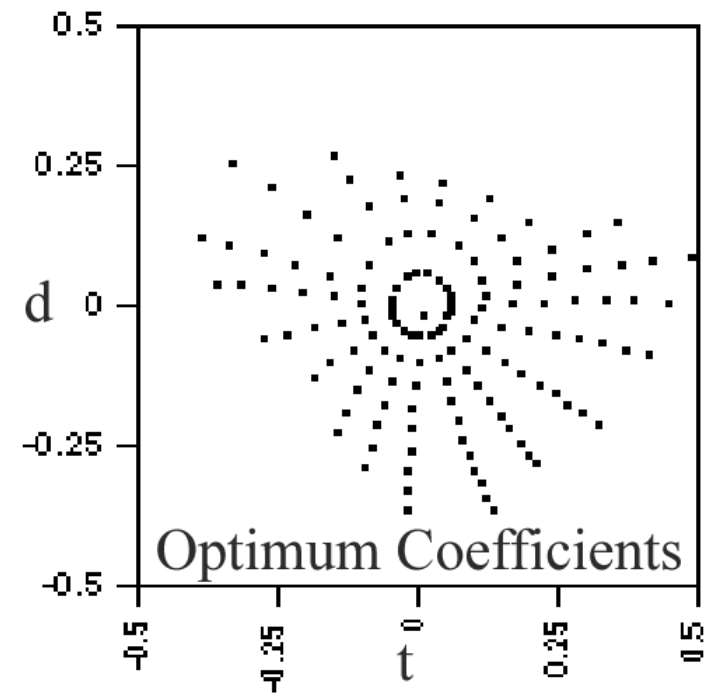
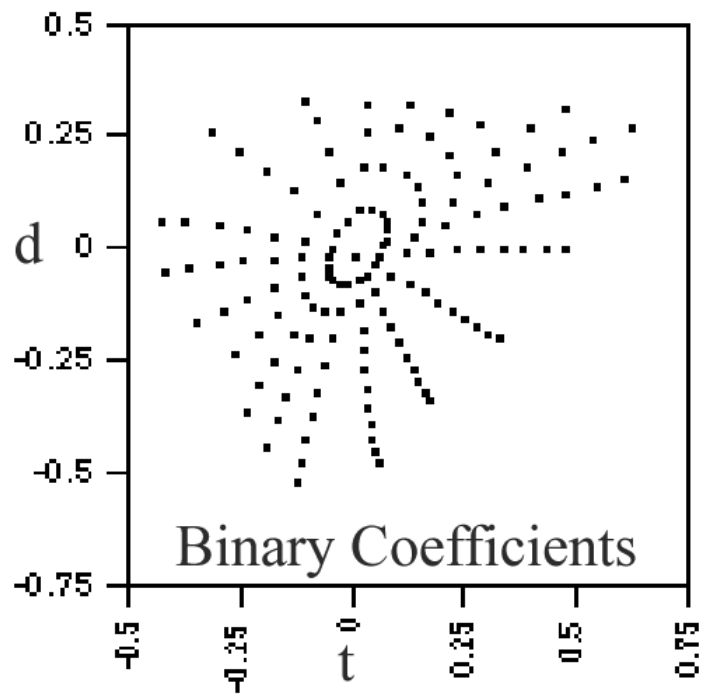
ATD COLOR SPACE

- $A = (R + 3 * G) / 4$

- $T = R - G$

- $D = (R + G - 2 * B) / 2$

COLOR SPACE UNIFORMITY





SOMETHING BORROWED

- Painters have trained to modify color with darkness
- Colorist model of reproduction

Louise Moillon



Hendrick ter Brugghen





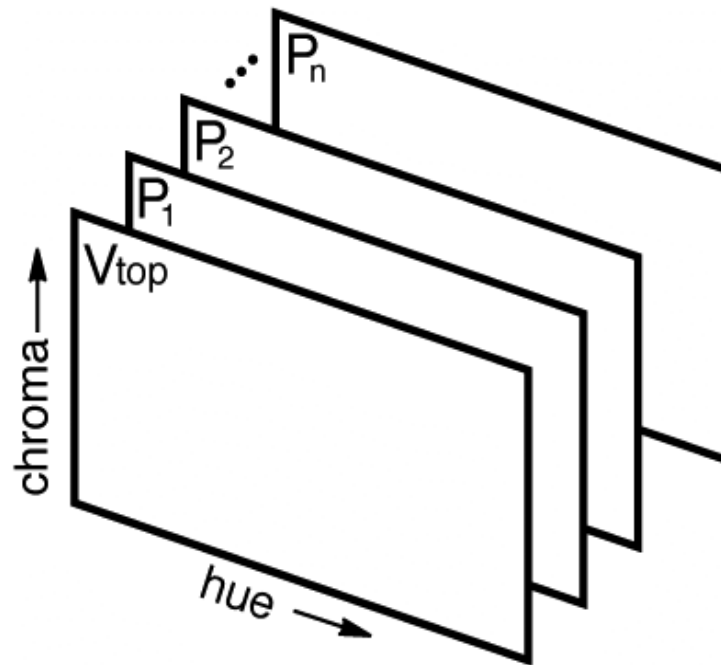
QUALIA

- $V = R + 3 * G / 2 + B$
- $t = T / V$
- $d = D / V$

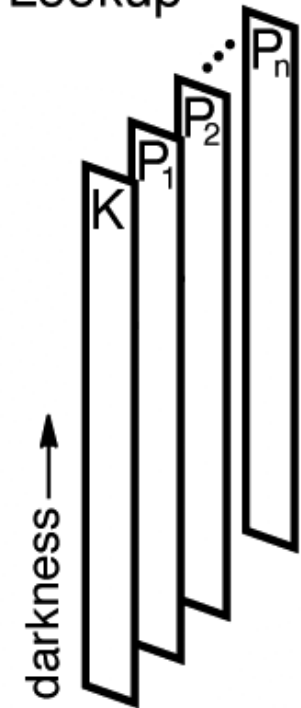
CHROMA - DARKNESS MODEL



2D Lookup



1D Lookup





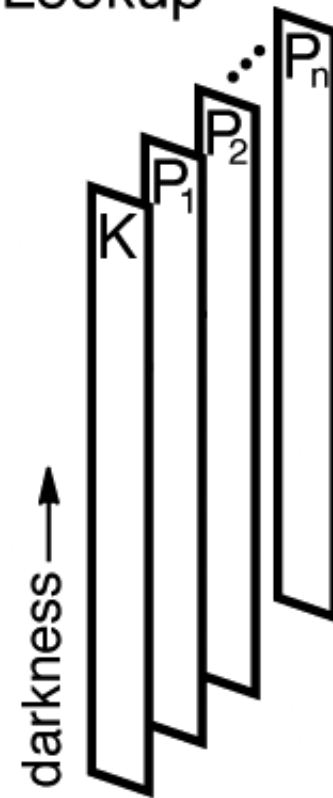
SOMETHING BLUE

- Choice of black model is no longer based on the 100 C, 80 M and 80 Y rule
- Quad tones of rich blue blacks can be created
- Paper can be integrated into the darkness model

COMPLEX BLACK MODEL

- The black model can be made up of any combination of colorants
- The dot amount at any level can be used to build very long and smooth blacks

1D Lookup



Value proposition



Input

Display

Duplicator

Press

Images perceived as identical



SUMMARY

- Spectral data is used to control devices
- Devices are independent
- mRGB is a superset PCS
- ATD - Qualia uses fast integer computation
- Near lossless “natural” appearance map to all output devices
- Documents require no attached profiles
- Reproduction is predictable over the entire range of media and colorants



Thank you

- Questions?