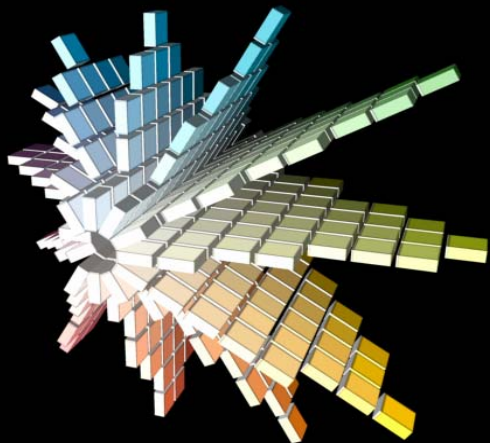
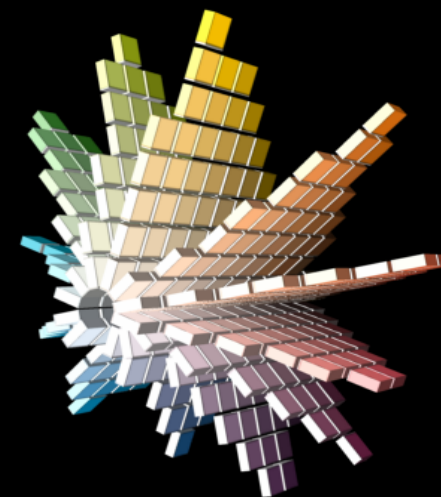
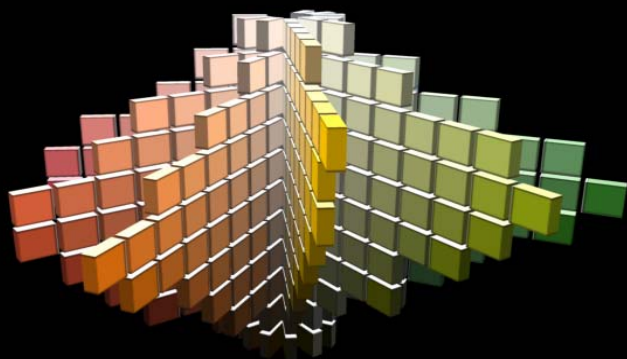




What is Color?



What is Color? 可見光範圍

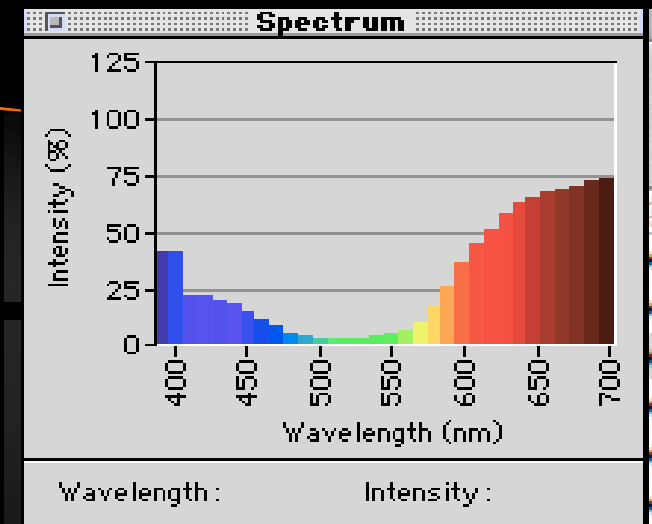
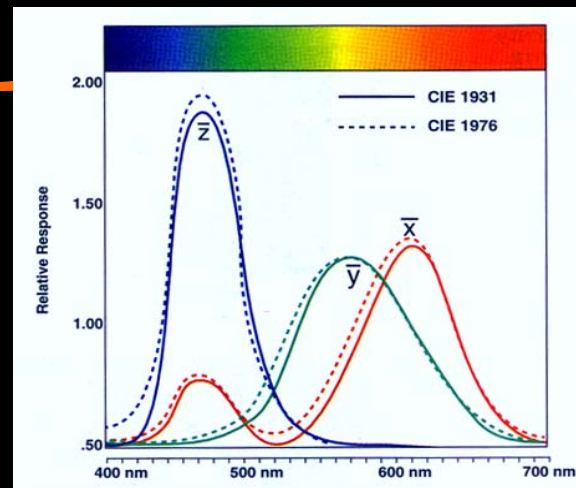
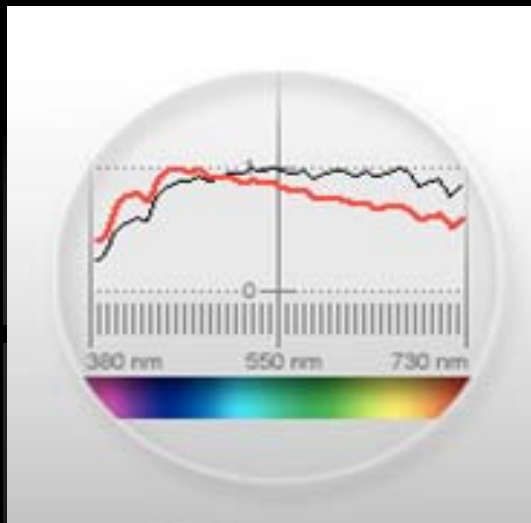


Isaac Newton
examining light with a
prism, while
simultaneously striking
a graceful pose

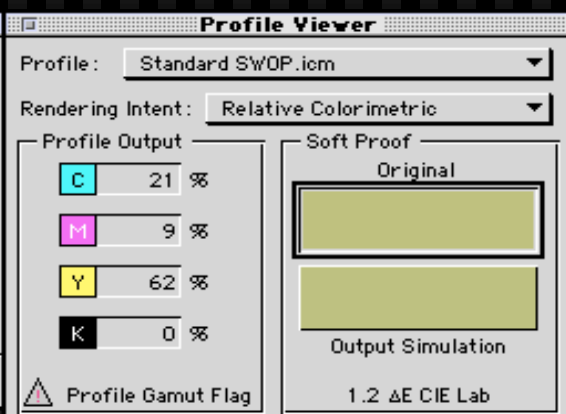
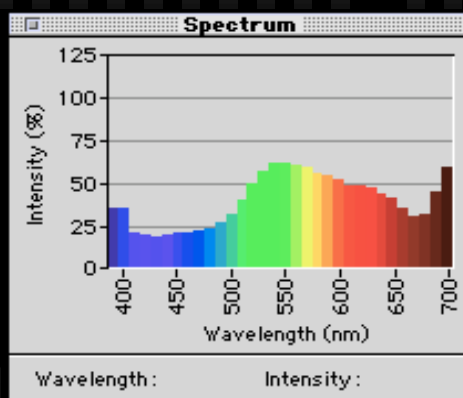
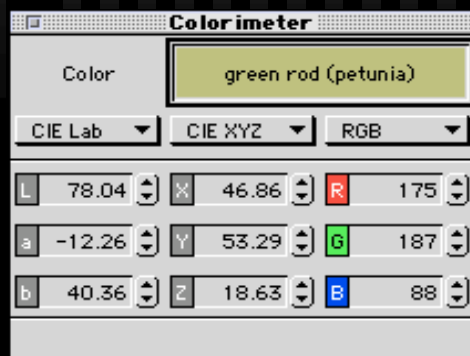
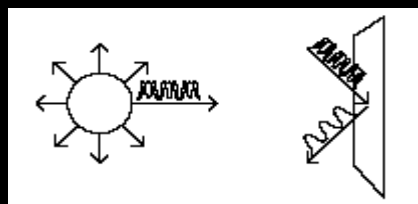
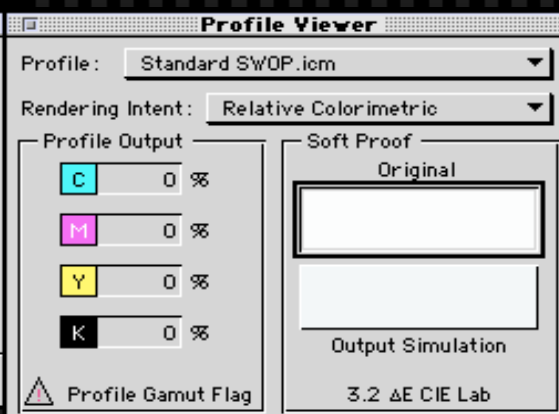
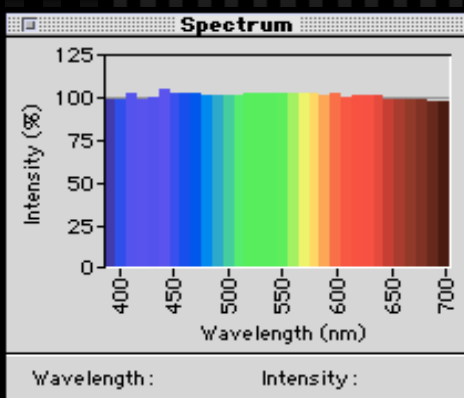
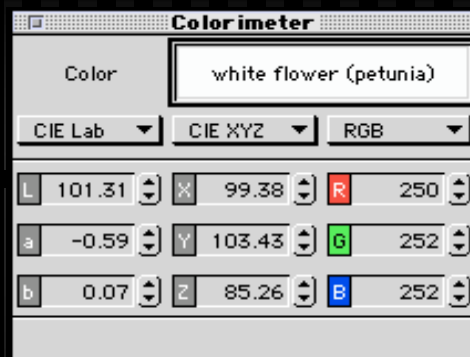
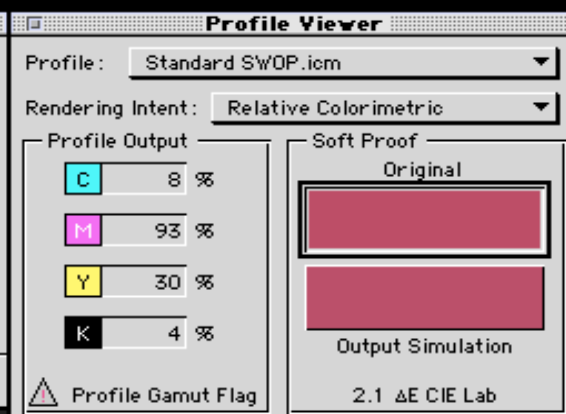
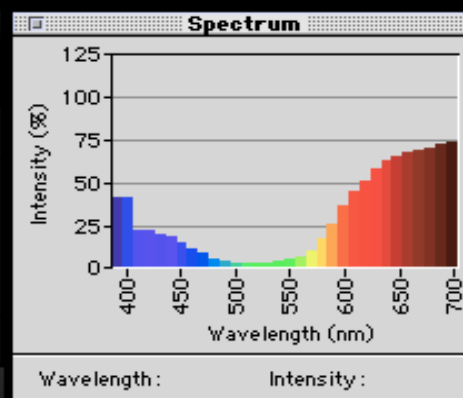
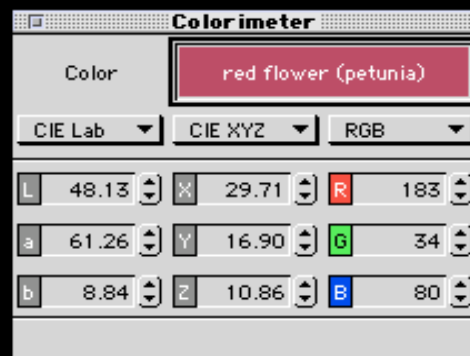
The breakthrough to the study of color was this: Newton turned our attention to the light source. Color was, for the first time, an identifiable property of light. White light contains all colors. If a surface appears to be yellow, this means that the light reaching our eyes has somehow been changed by reflecting off that surface. No light, no color. (For a description of Newton's experiment, [see sidebar.](#))



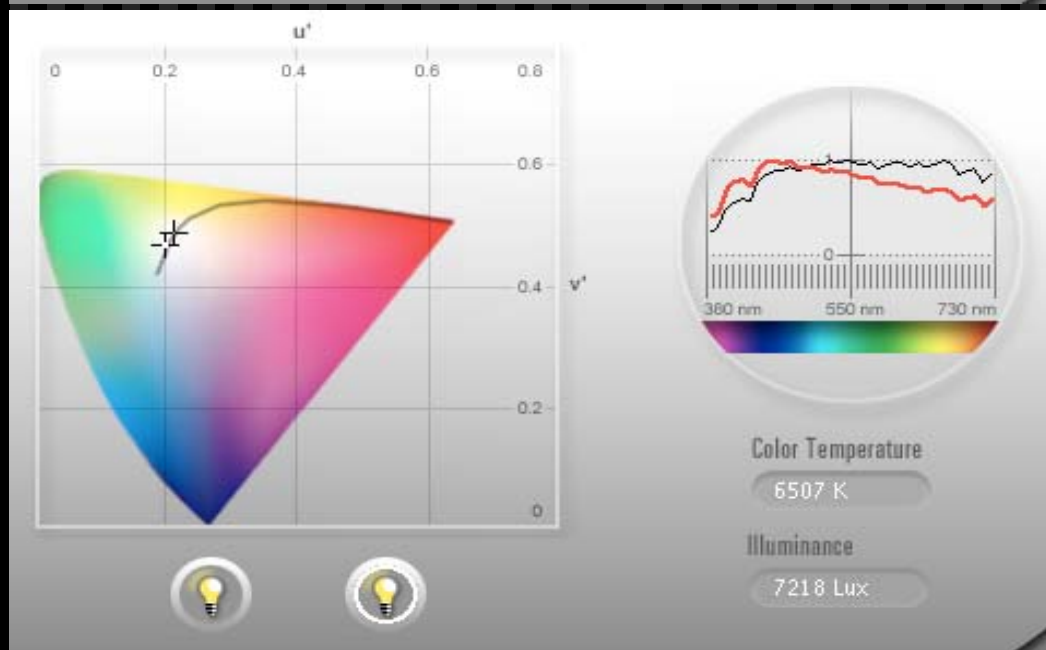
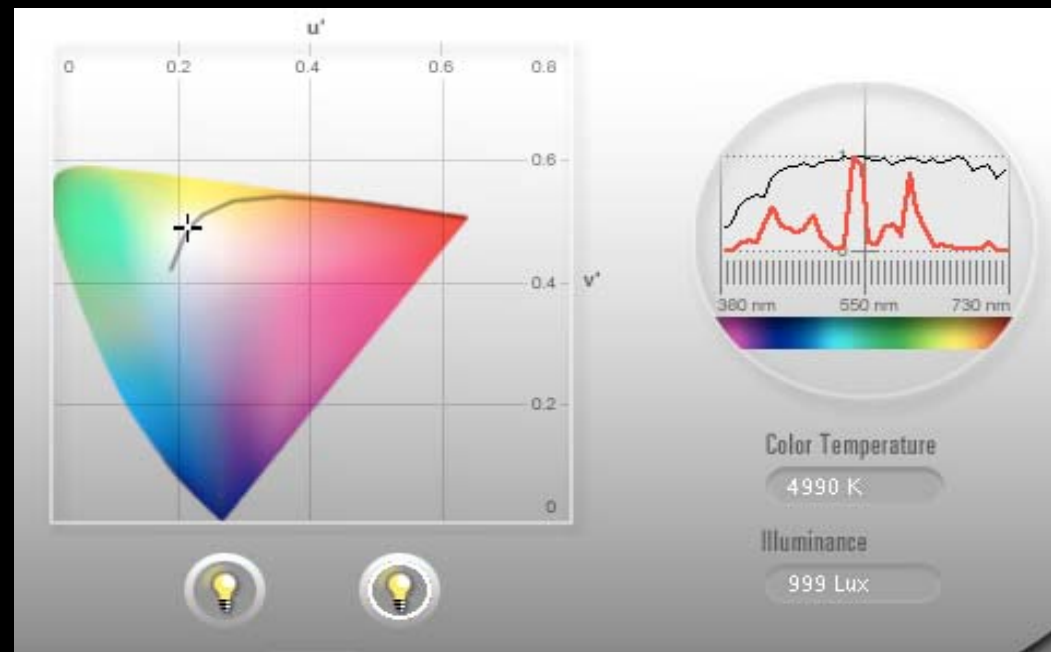
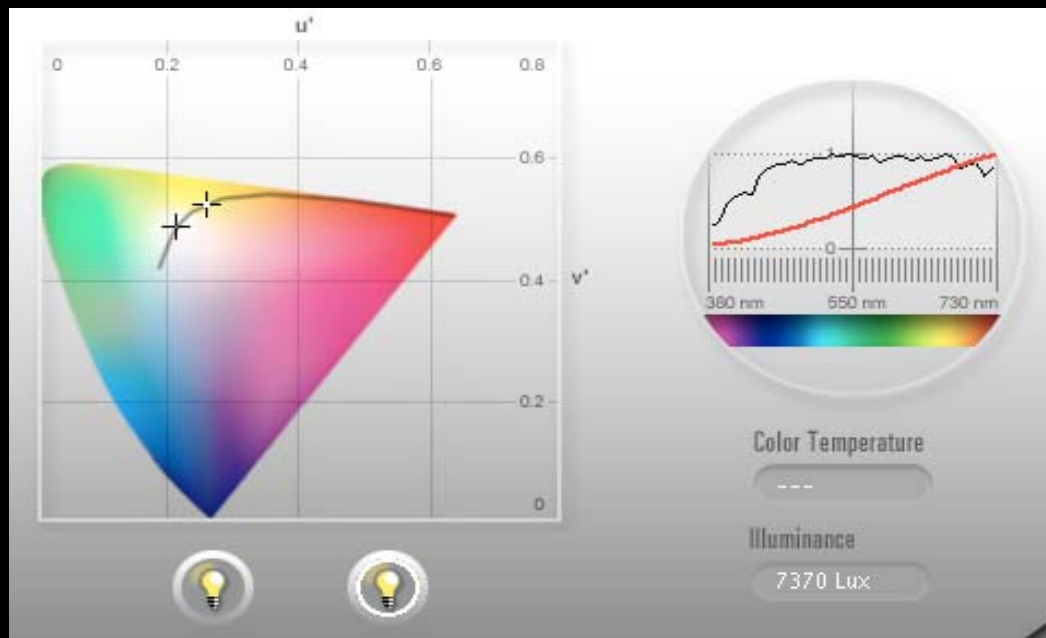
What is color? 光源,眼睛,物體



What is color? 光源,眼睛,物體



What is color? 光源,眼睛,物體

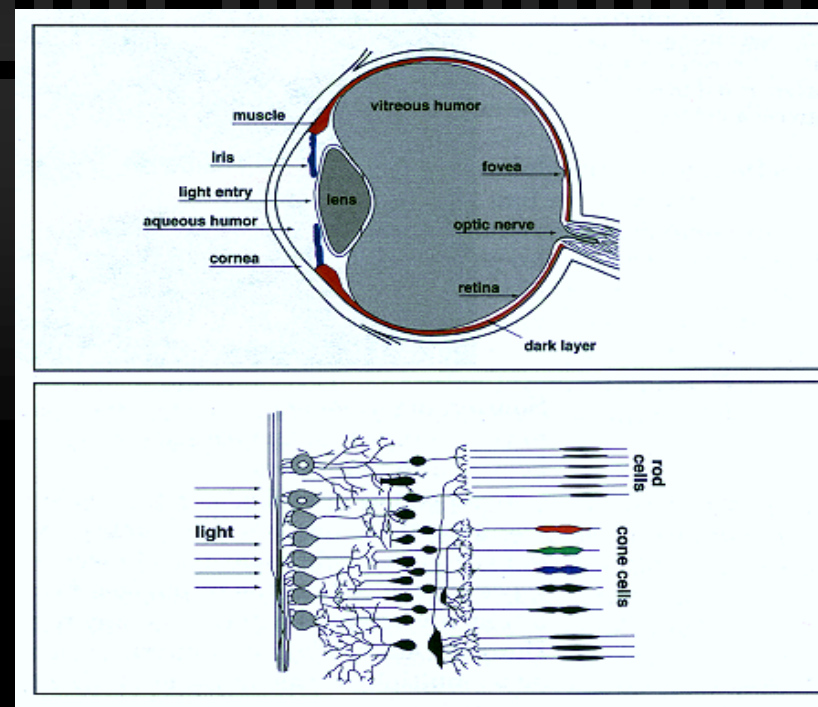
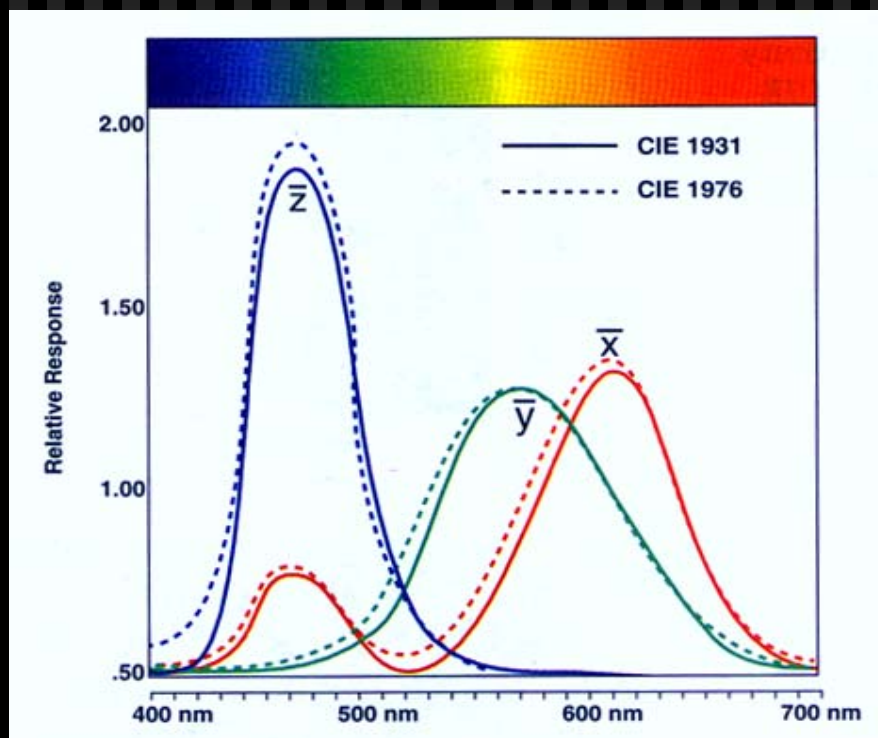
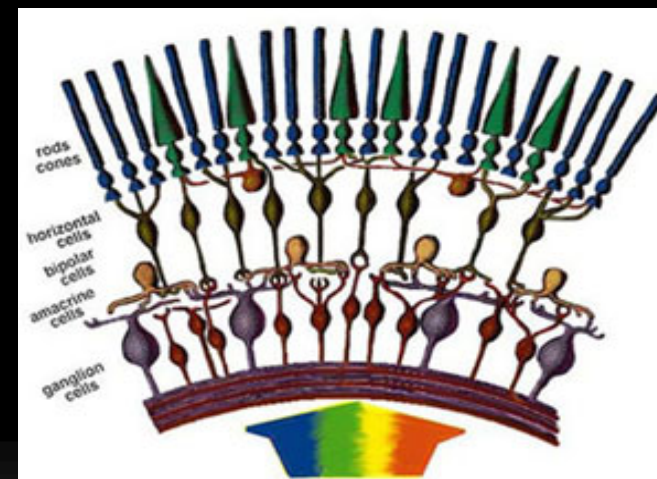


A	F10
D65	

What is color? 光源,眼睛,物體

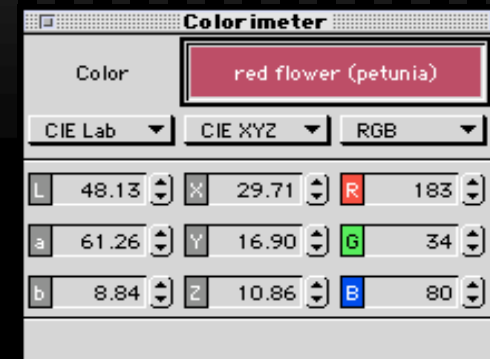
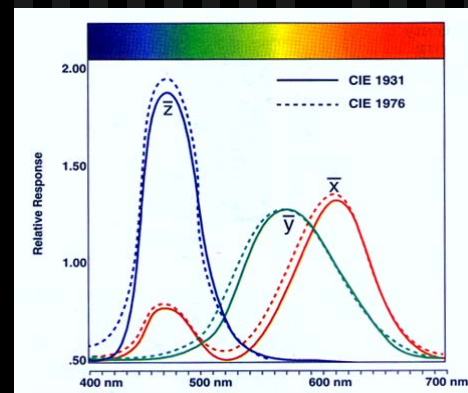
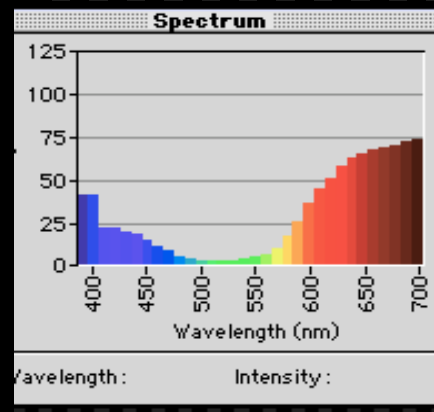
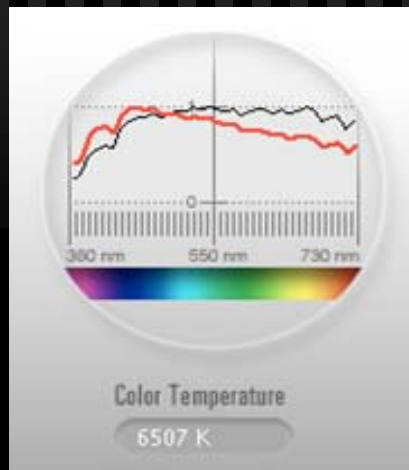
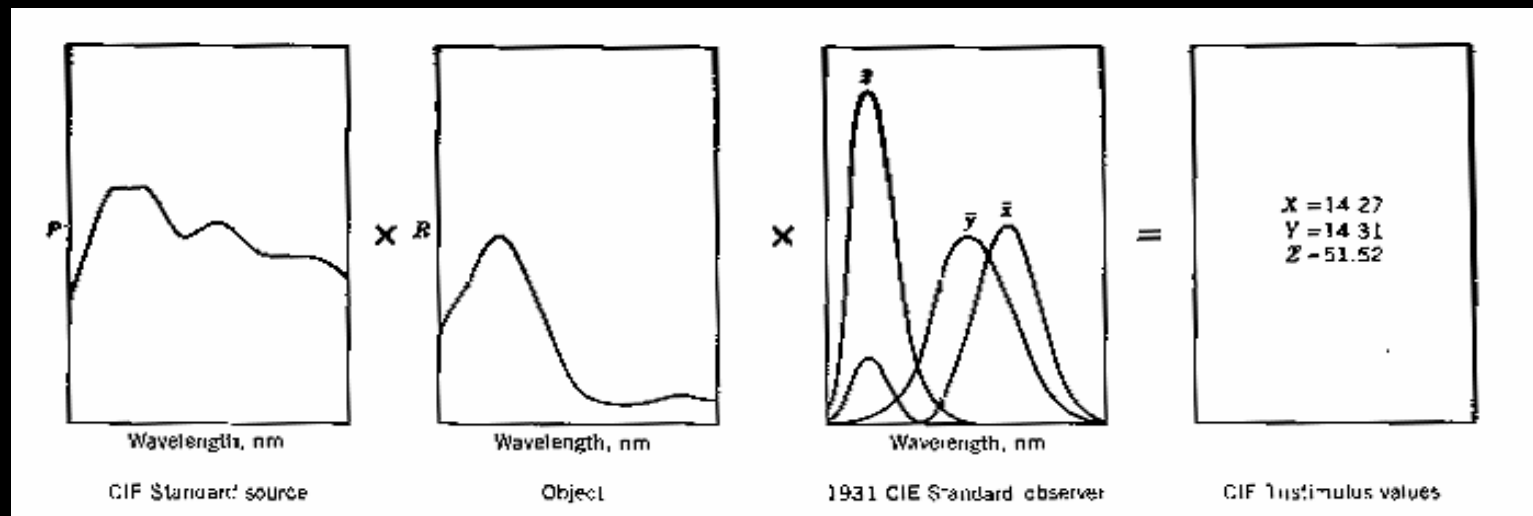
錐狀細胞Cone: 感色

桿狀細胞Rod: 感明暗



What is color? 光源,眼睛,物體

光線



What is color? Delta-E 色差

CIE xyY

CIE L*a*b*

$$x = X/(X+Y+Z)$$

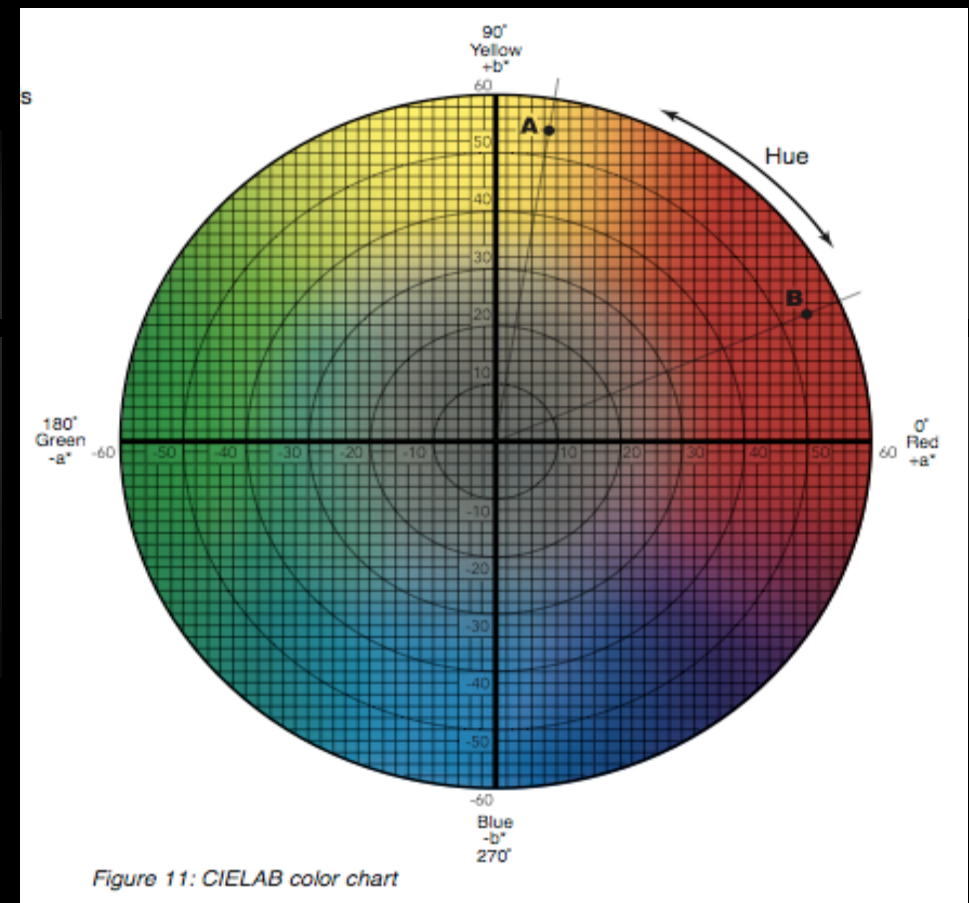
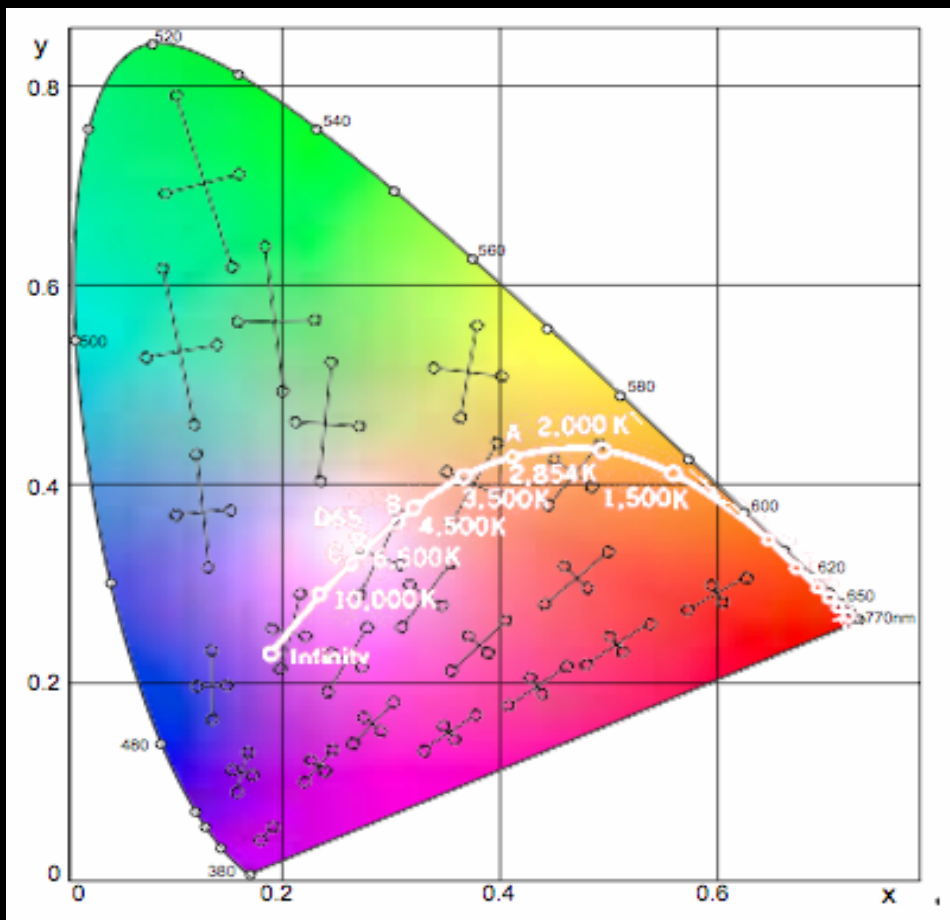
$$y = Y/(X+Y+Z)$$

$$z = Z/(X+Y+Z)$$

$$L = 116(Y/Y_n)^{1/3} - 16$$

$$a = 500[(X/X_n)^{1/3} - (Y/Y_n)^{1/3}]$$

$$b = 200[(Y/Y_n)^{1/3} - (Z/Z_n)^{1/3}]$$



What is color? Color CIELAB Tolerancing 色差容許

CIE Lab

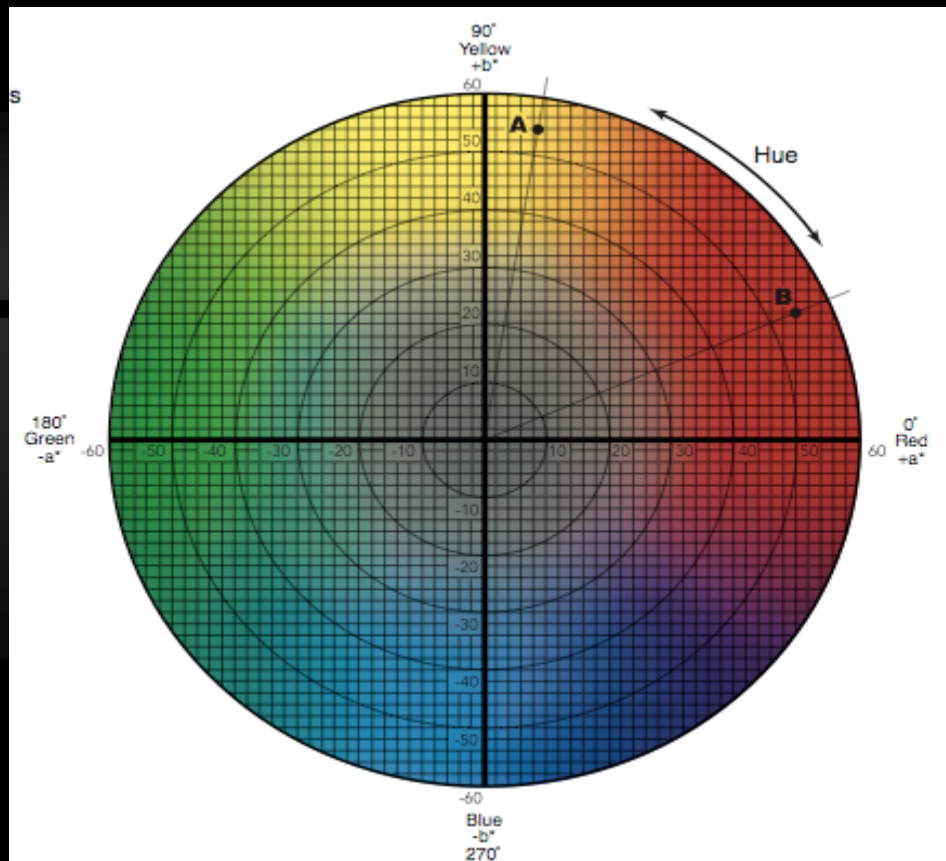


Figure 11: CIELAB color chart

CIE CMC

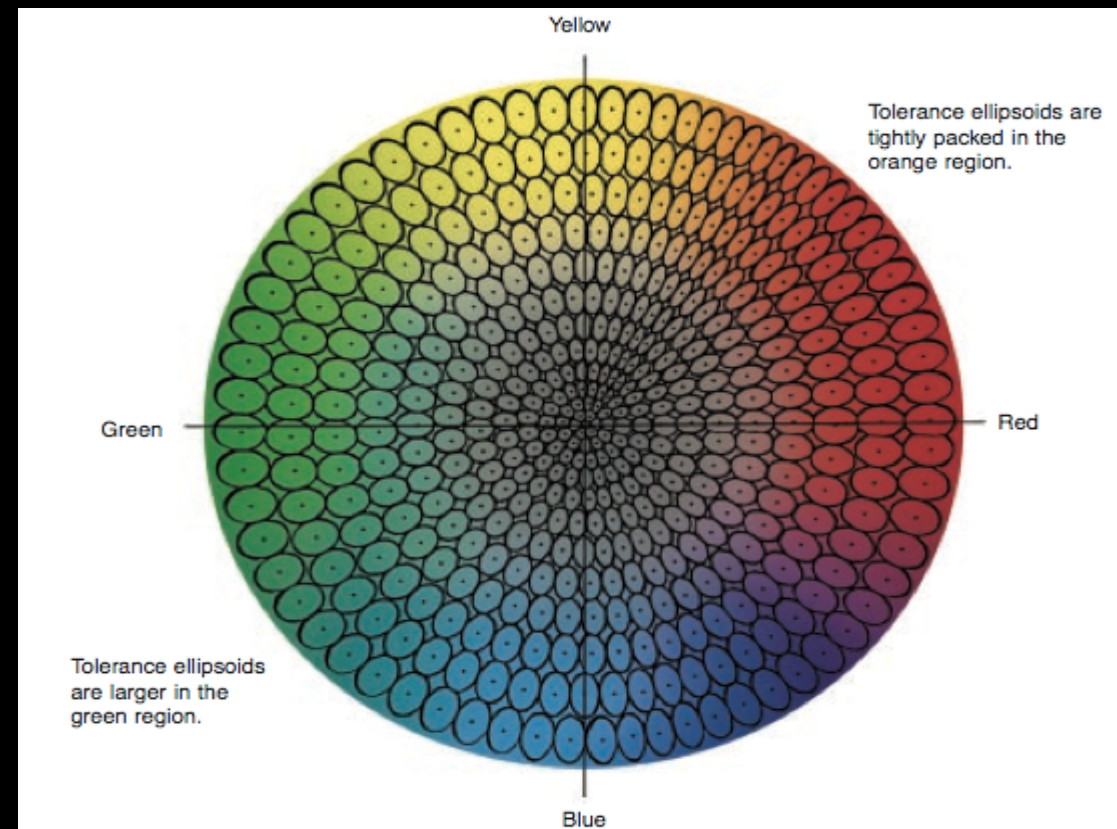
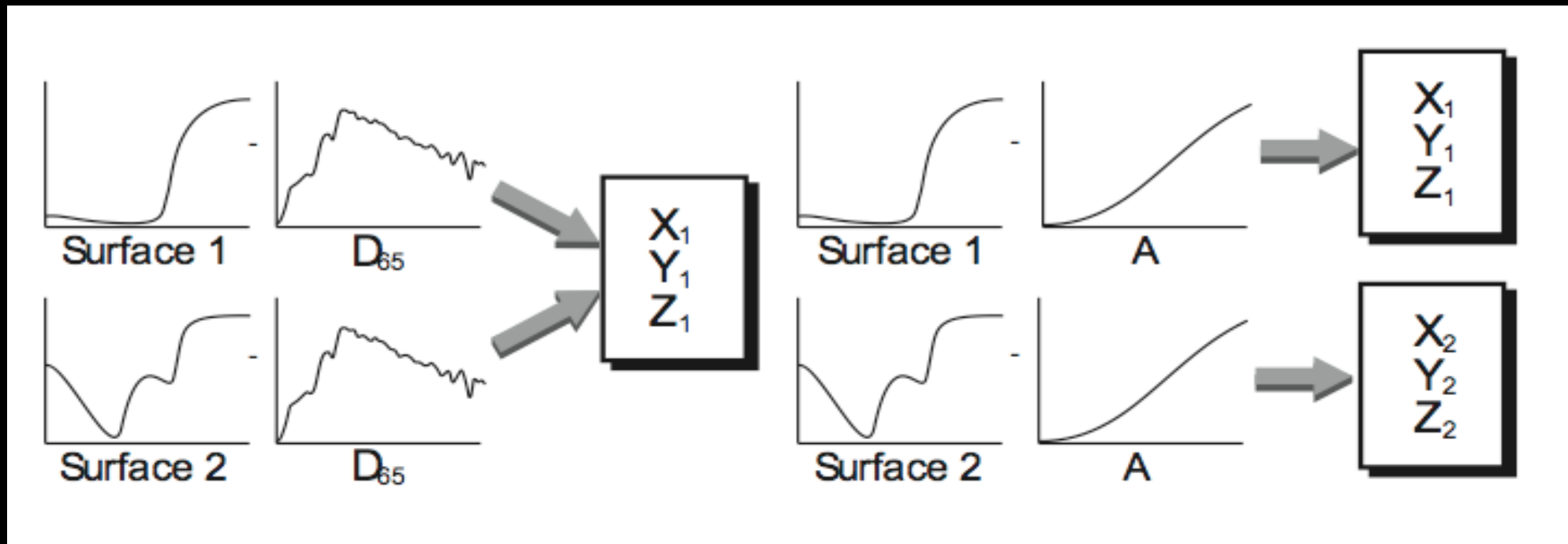


Figure 18: Tolerance ellipsoids in color space

What is color? Metamerism (同色異譜)



What is color? Attributes of Color: Hue, Chroma, Lightness

色彩標示特性: 色角度, 飽和度, 明度

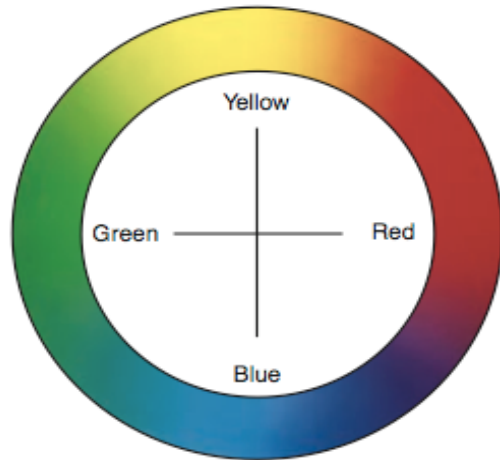


Figure 1: Hue

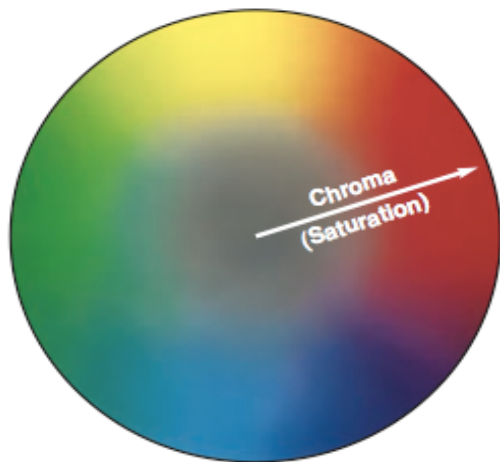
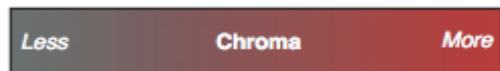


Figure 2: Chromaticity

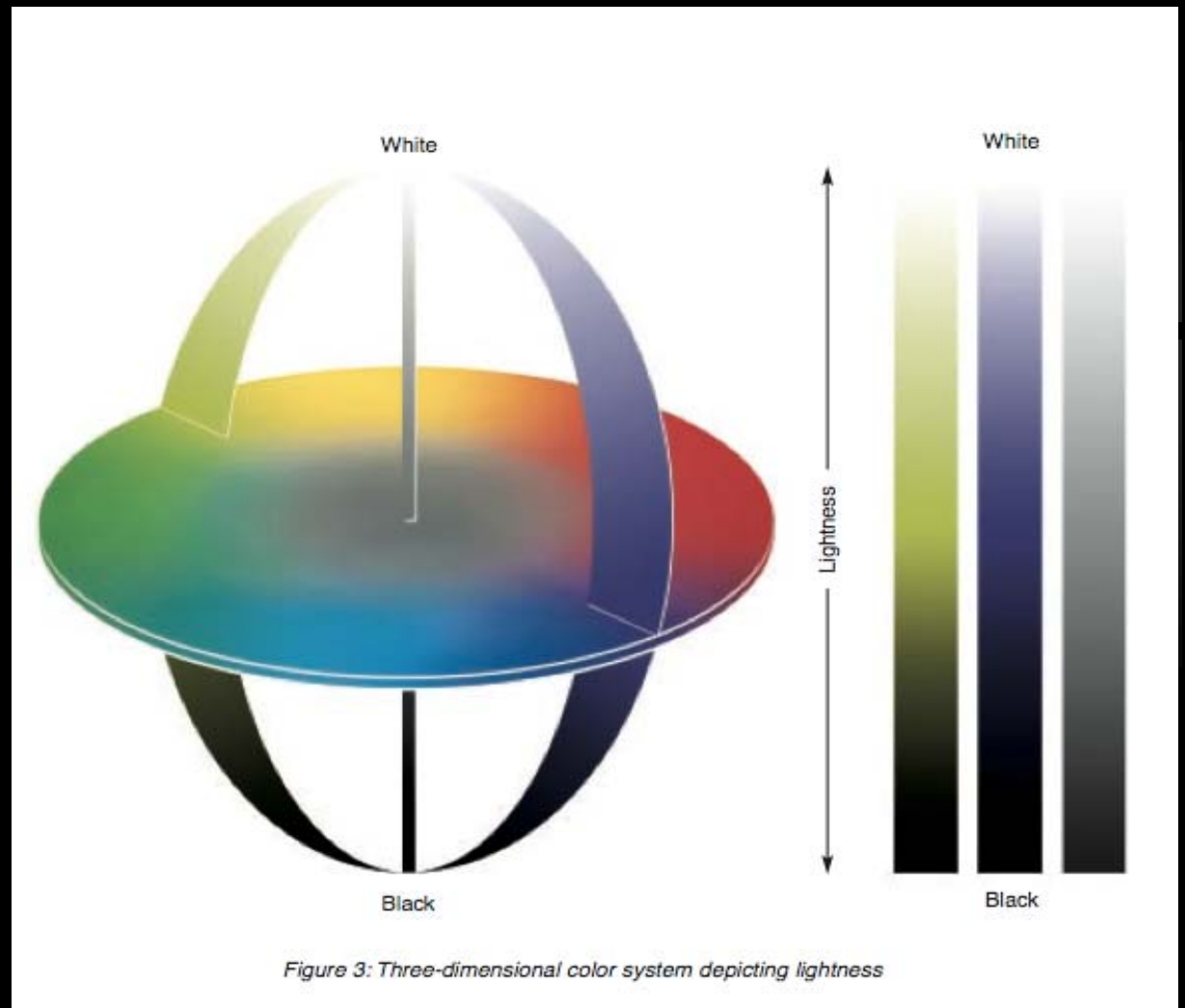
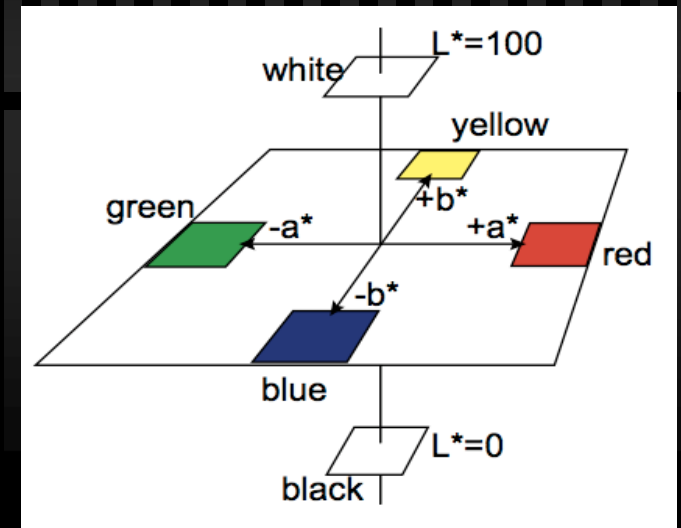
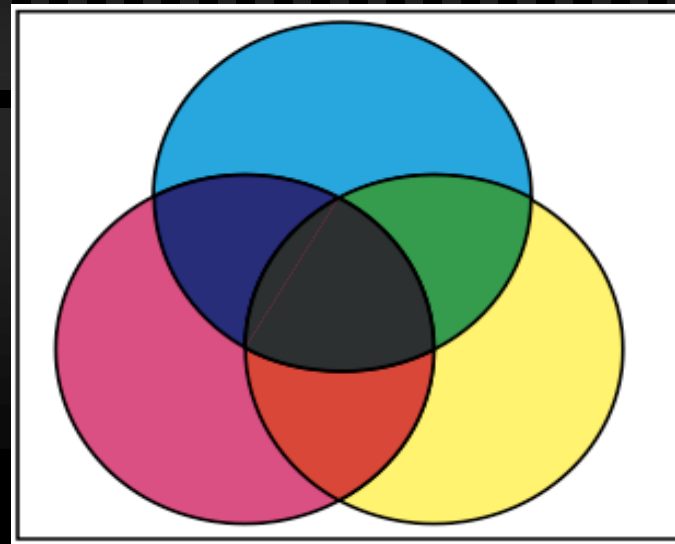
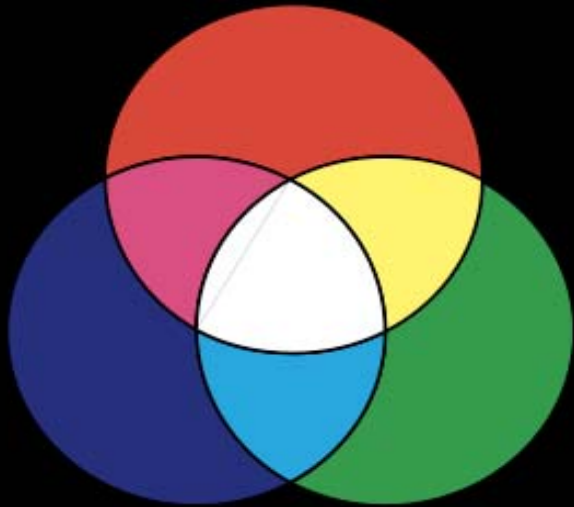


Figure 3: Three-dimensional color system depicting lightness

What is color? Color Space: RGB, CMYK. CIE

Device dependent: RGB, CMYK

Device independent: CIE

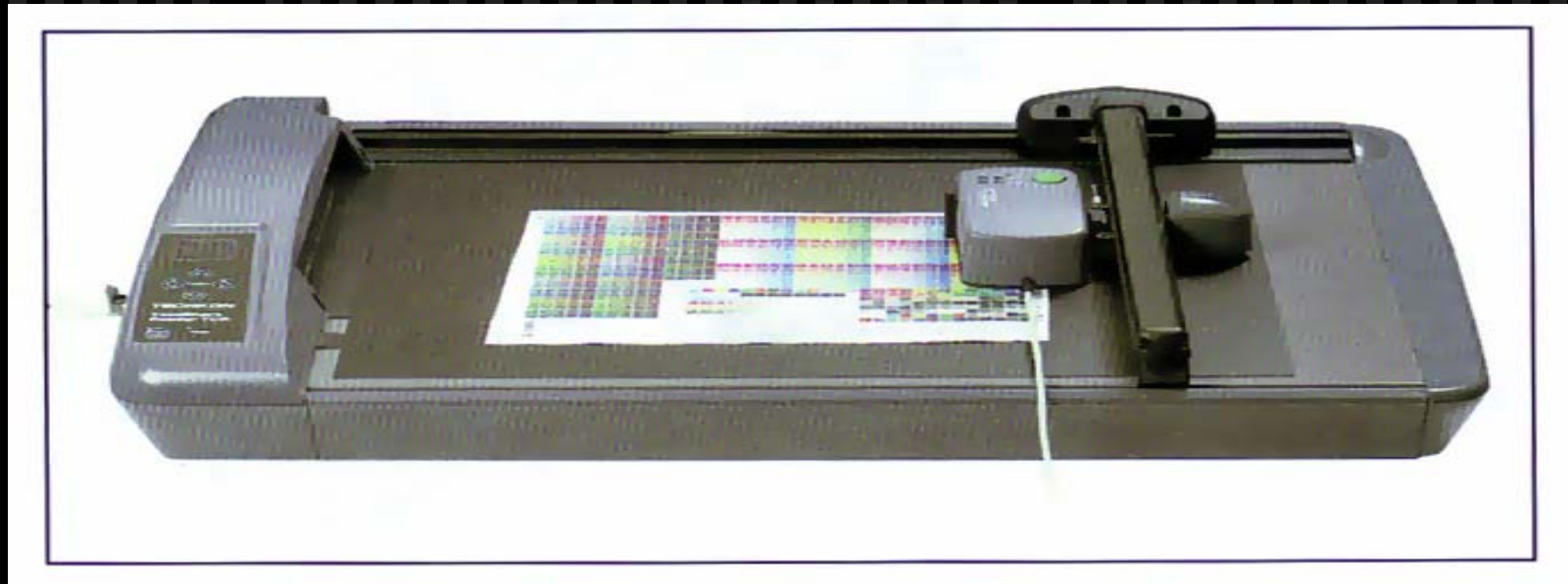


爲什麼需要獨立的色彩空間?

- ✓ 設備空間(RGB,CMYK)溝通失敗
 - ✓ 同一組RGB資料在不同的螢幕顯示不相同
 - ✓ 同一張原稿在不同的掃描機得到不同的RGB資料
 - ✓ 同一組CMYK資料在不同的印表機得到不同的色彩
- ✓ 獨立色彩空間(CIE Space)的特性
 - ✓ 一種以人的眼睛與光源爲基礎的色彩標示座標
 - ✓ 一種將人的眼睛與光源帶著跑的色彩座標

設備空間如何與獨立色彩空間溝通？

- ✓ 對設備空間取樣,經由色度計或光譜儀量取設備樣本的獨立空間色彩值,由樣本與色彩值之間的關係可推算出設備空間與獨立色彩空間的對應關係。



輸入設備如何與獨立色彩空間溝通?

✓ SG Target

- ✓ 取樣 (140 patches)
- ✓ 量取色彩值
- ✓ 建立對應關係



繼續

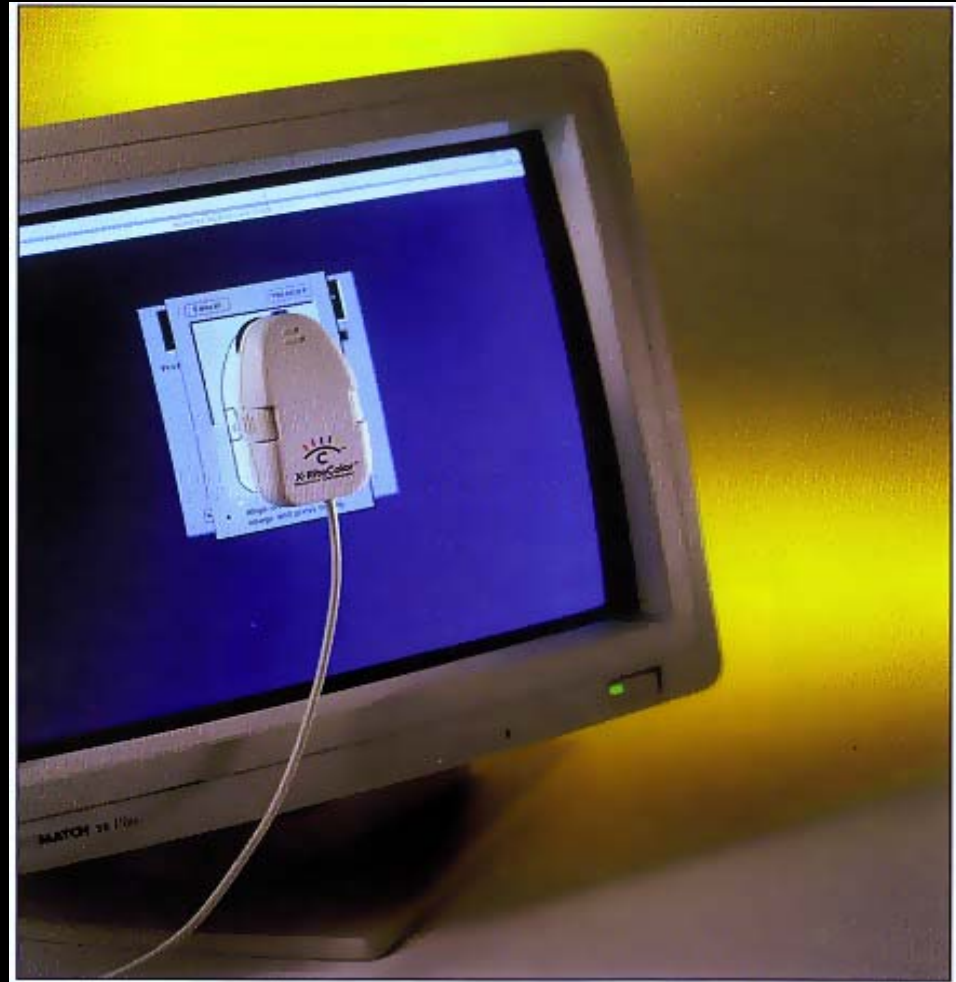
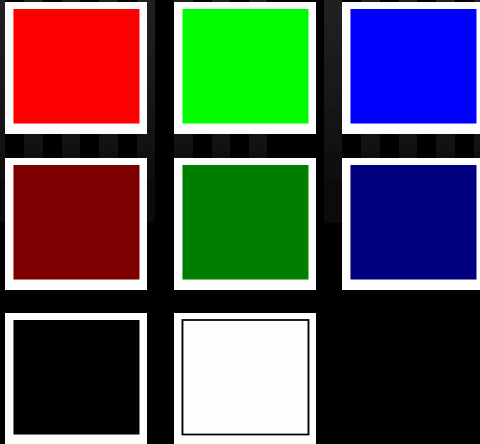
顯像設備如何與獨立色彩空間溝通？

✓ 顯像設備

✓ 取樣

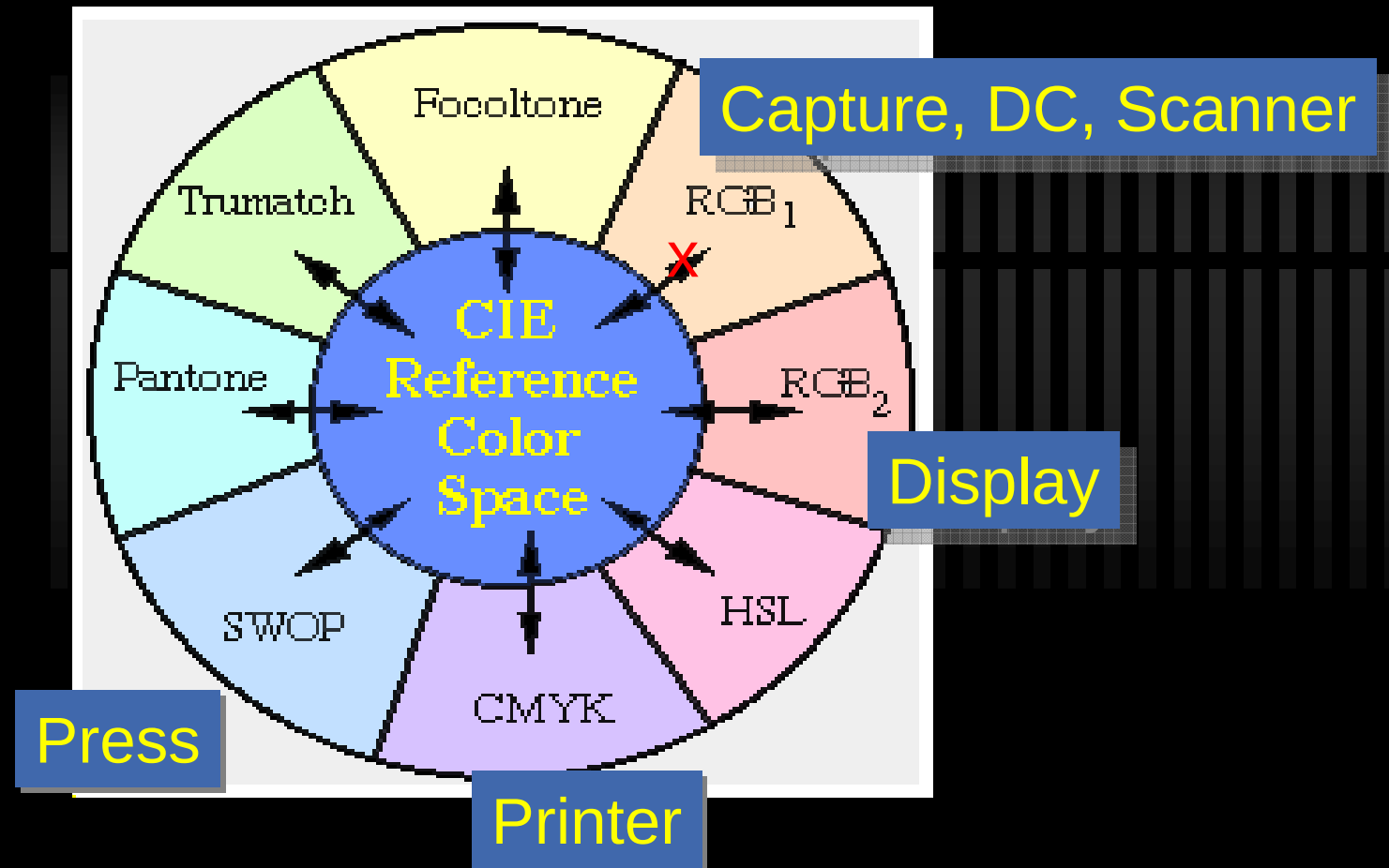
✓ 量取色彩值

✓ 建立對應關係

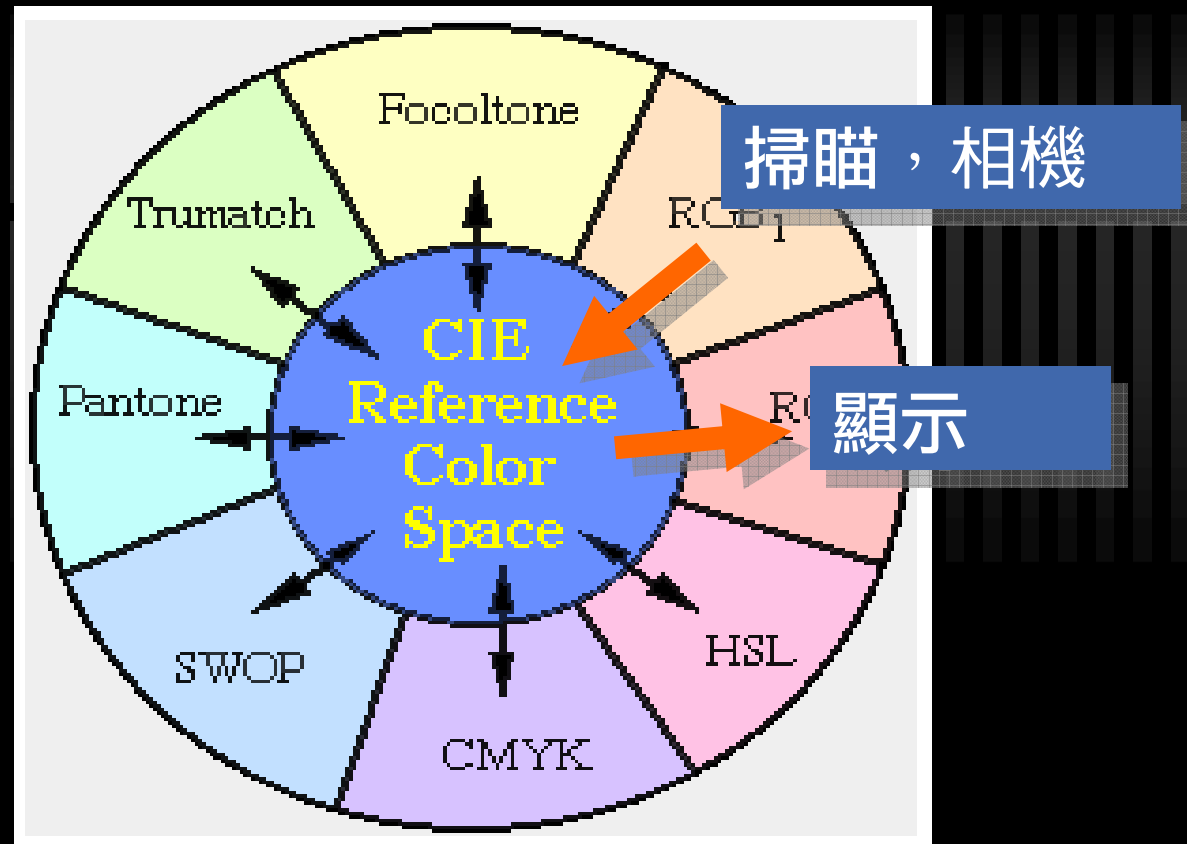


繼續

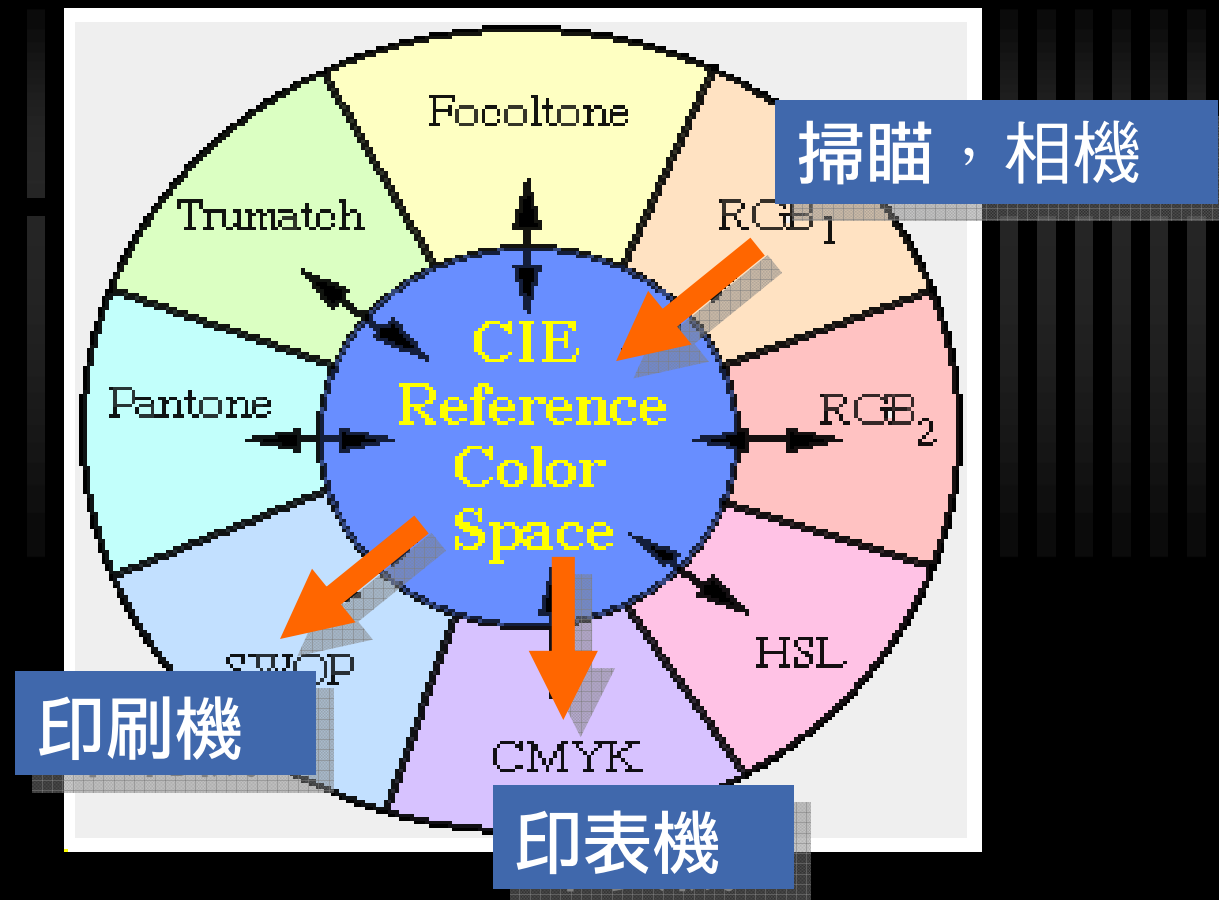
CMS application



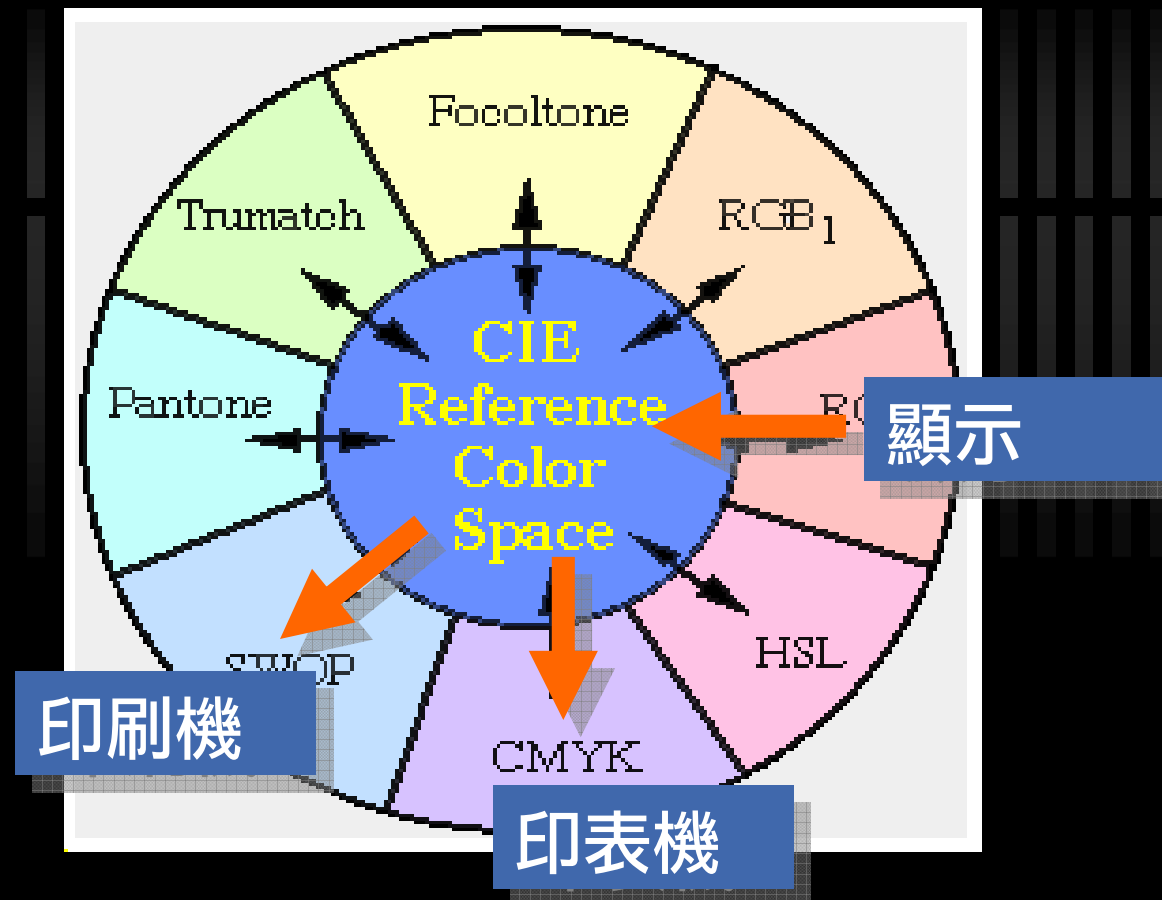
CMS application (Web, 數位典藏)



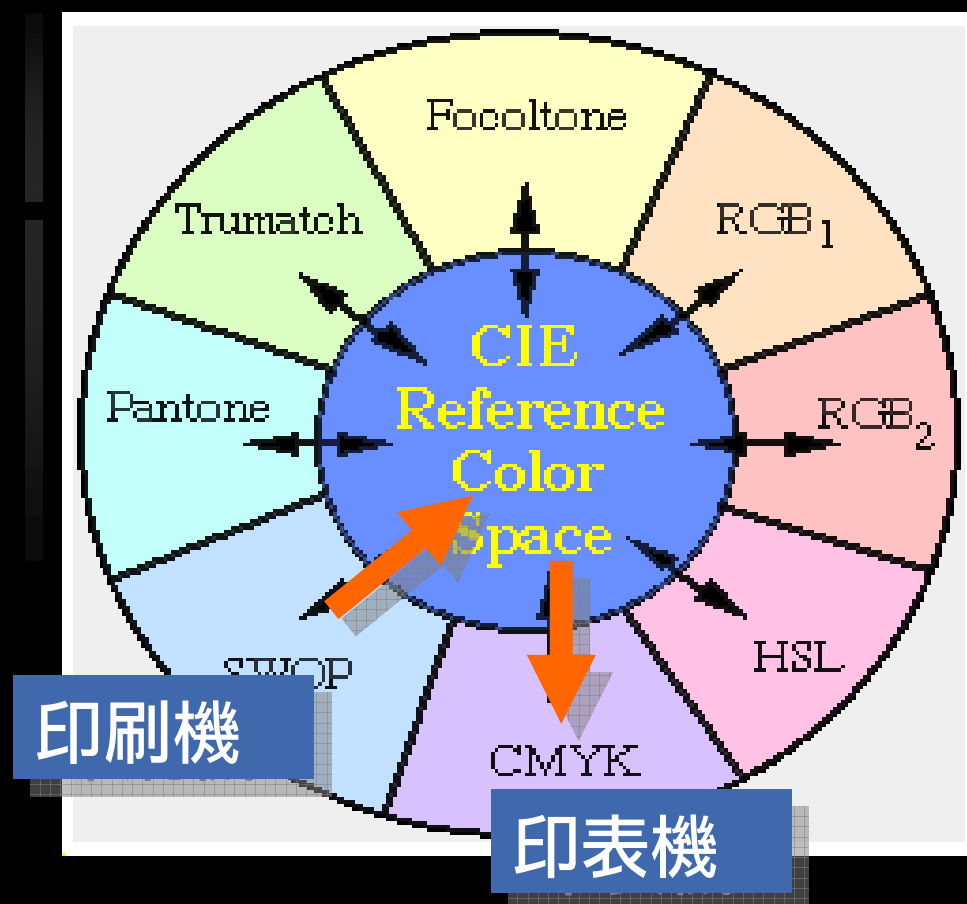
CMS application(出版，相片沖印)



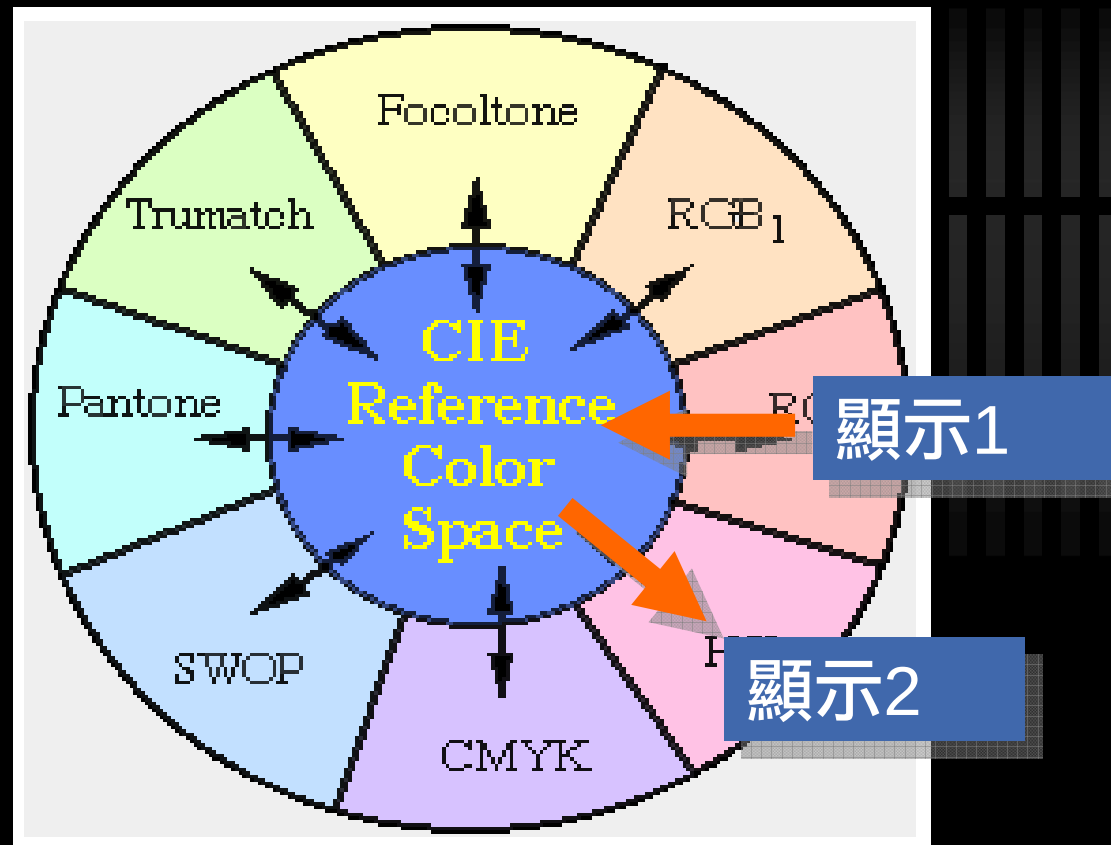
CMS application(出版，平面設計)



CMS application(打樣)

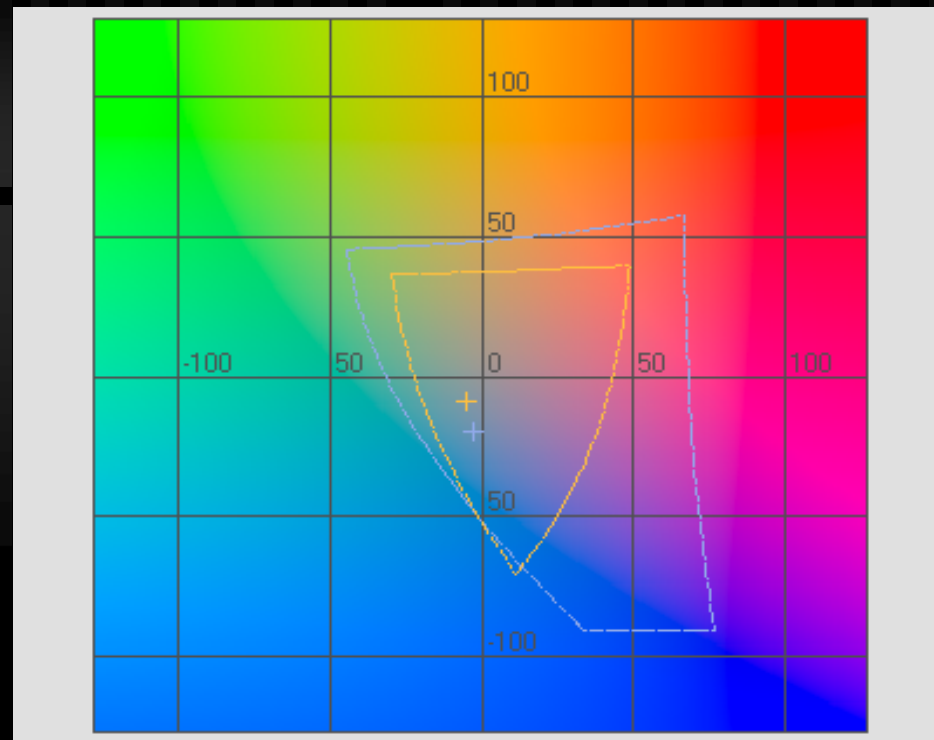
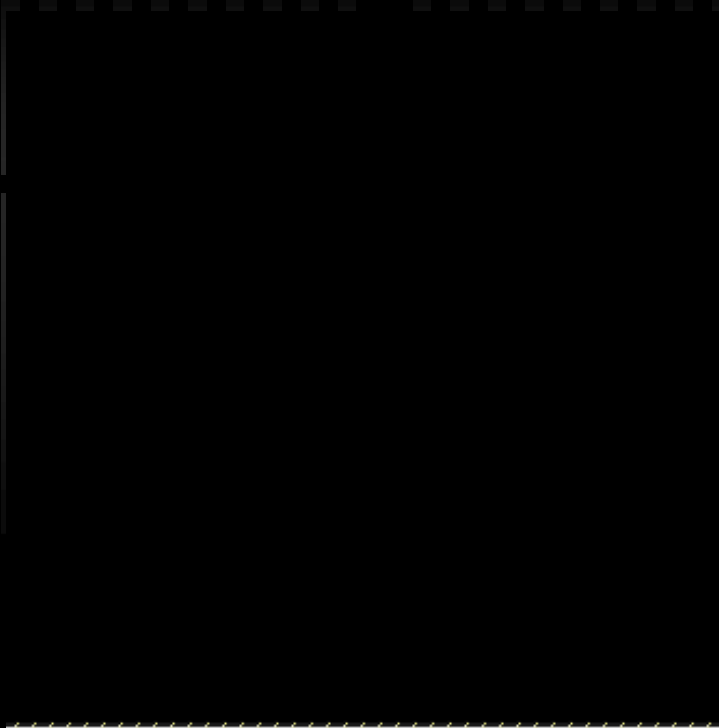


CMS application(網頁，多媒體)



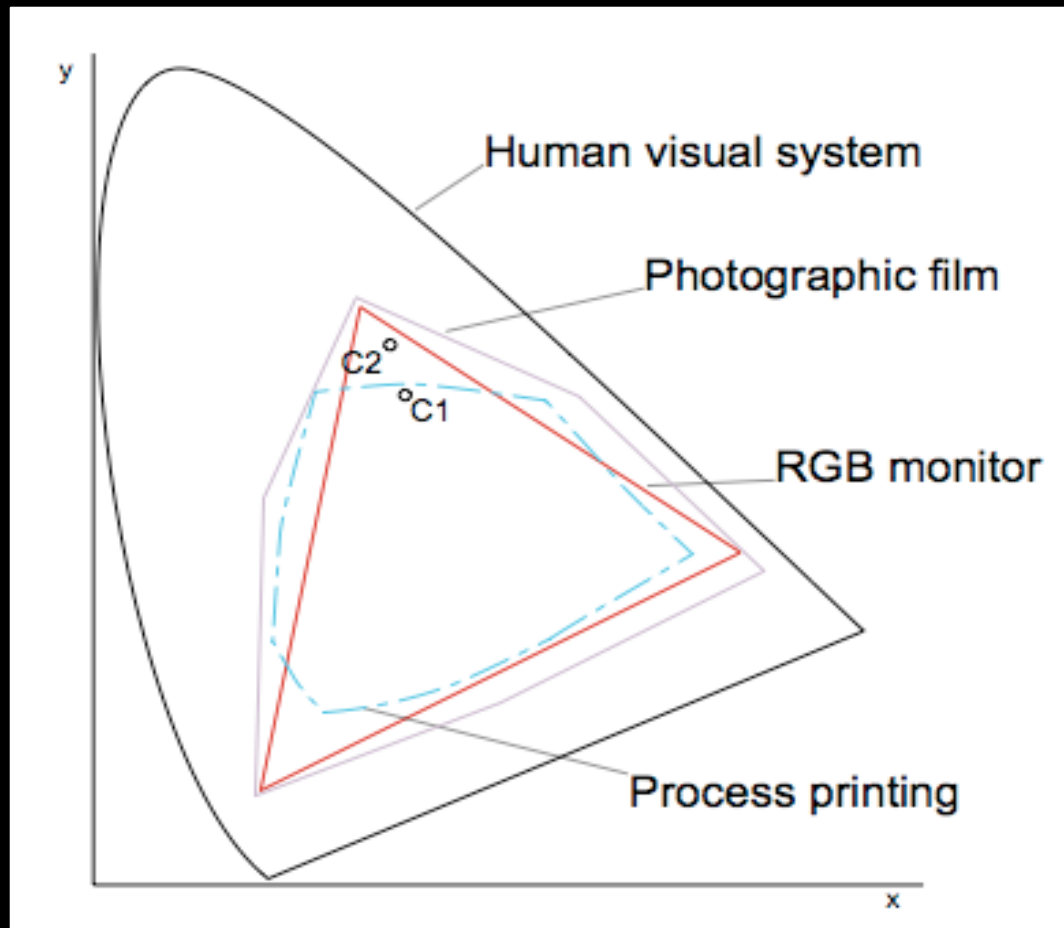
溝通的限制:色域(color gamut)

✓ sRGB vs. Macbook



What is color? Color Gamut 色域

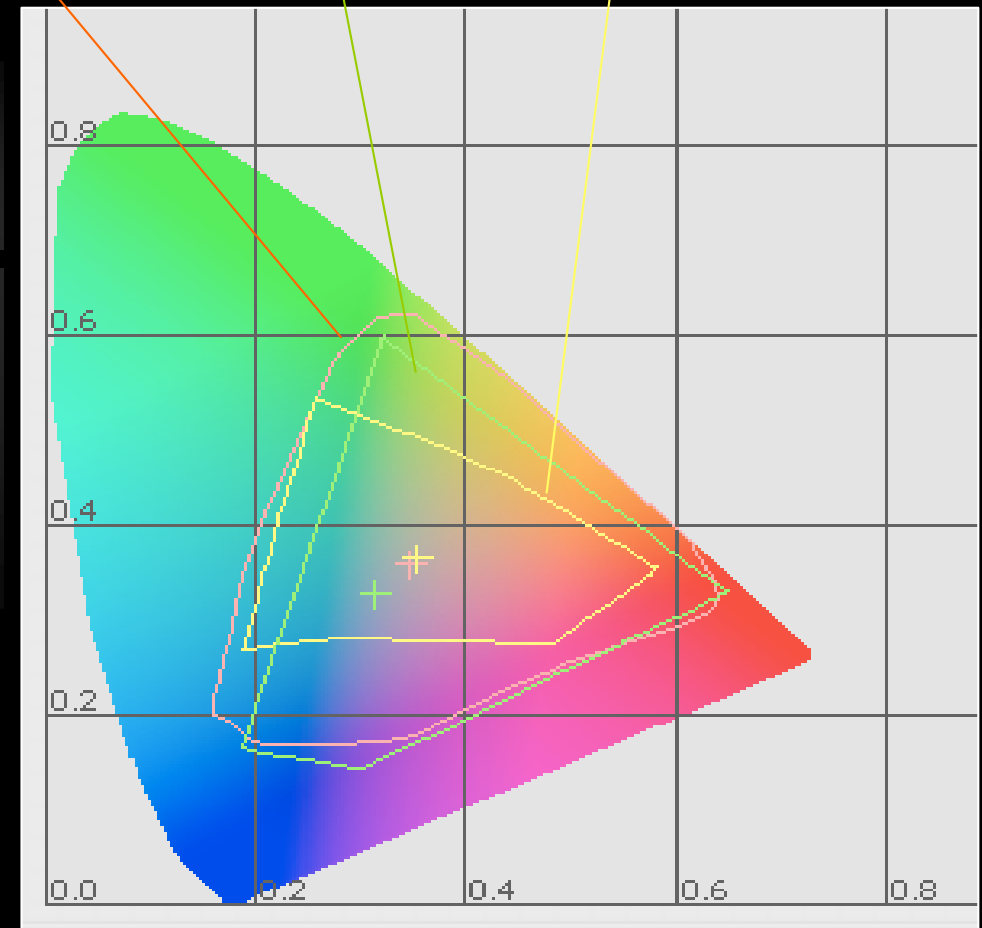
Color Gamut 色域



Kigamo

sRGB

SWOP *L=50



色域對應 Gamut Mapping application

感應式: Perceptual, 等比例縮放, 影像適用, Photoshop 內定

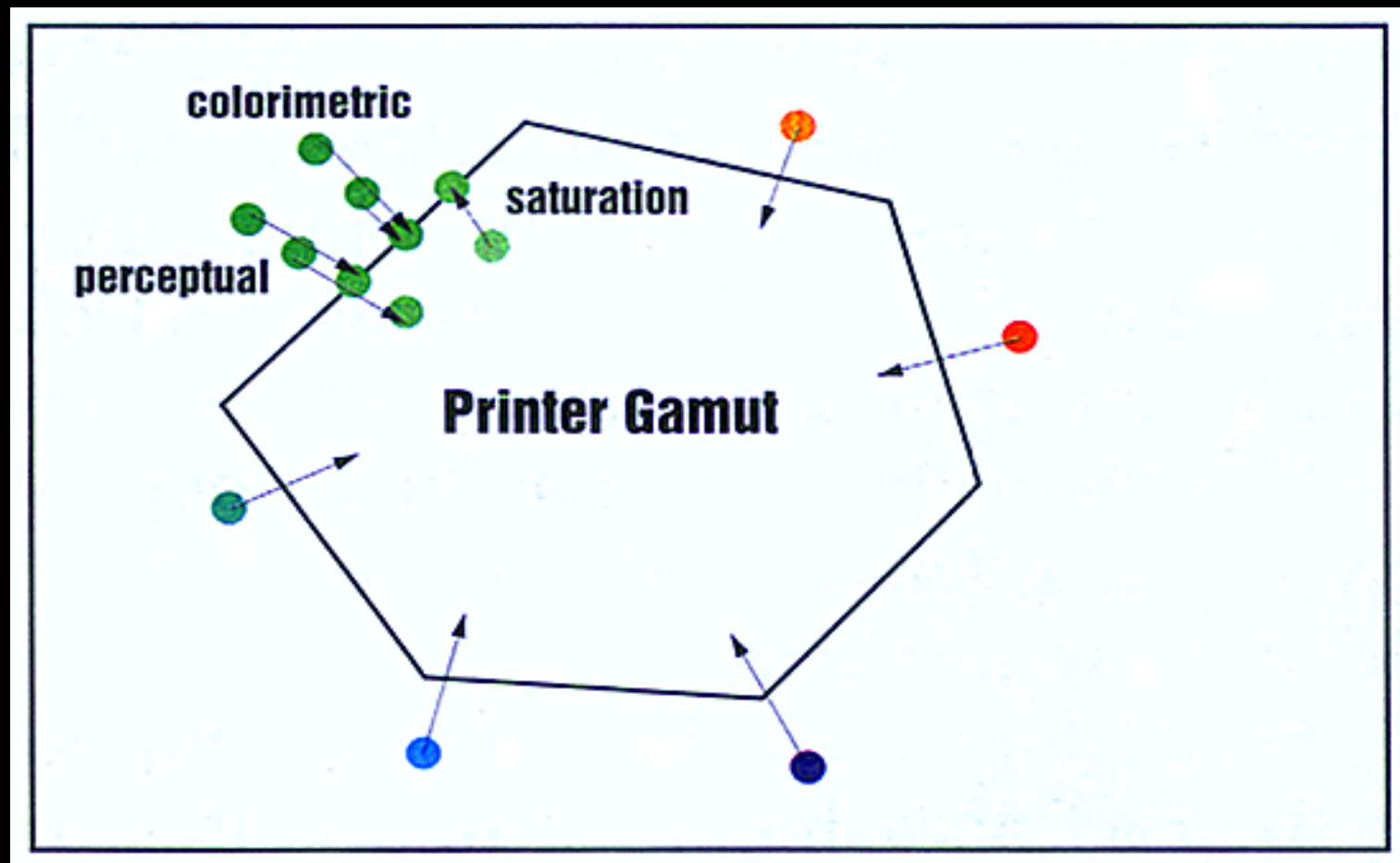
色度式: Colorimetric

絕對: Absolute: 白紙計算, 最精確, 數位打樣適用

相對: Relative: 白紙不計算, 調子較順暢, Illustrator 內定, CI, Logo 適用

飽合式: Saturation, 商用圖表適用

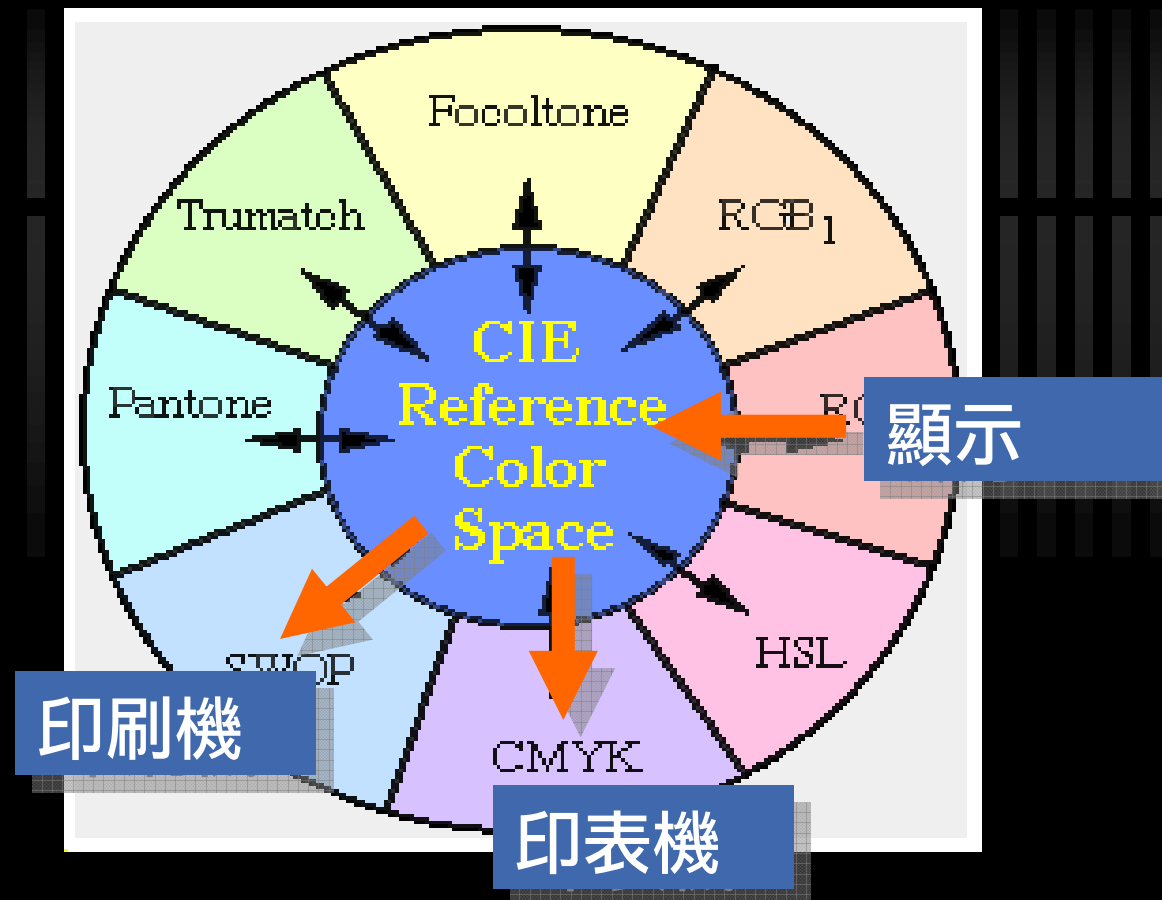
色域對應 Gamut Mapping





Part #2 Designer's Demo

CMS application(出版，平面設計)



Designer's Demo #1: 豬年卡片



Demo #1: 豬年卡片



- ✓ 創作環境: Photoshop CS2 on Win XP on BenQ FP767 LCD display
- ✓ 列印環境: Canon IP4200 on Canon 原廠墨水 on Oji RC paper
- ✓ Help!:: **怎麼印都不對!!**

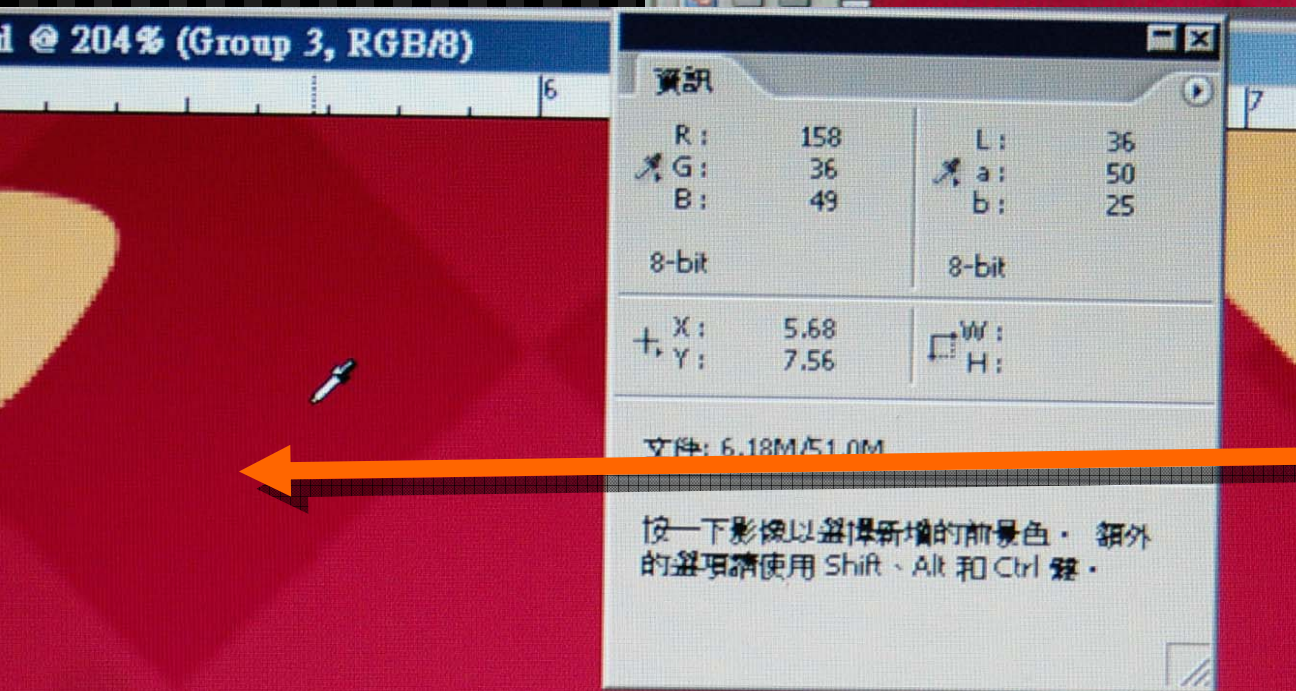
Demo #1: 豬年卡片

- ✓ 顯示器方面
- ✓ 色彩來源: Designer's mind on Photoshop
RGB 色板 on BenQ FP767



Demo #1: 豬年卡片

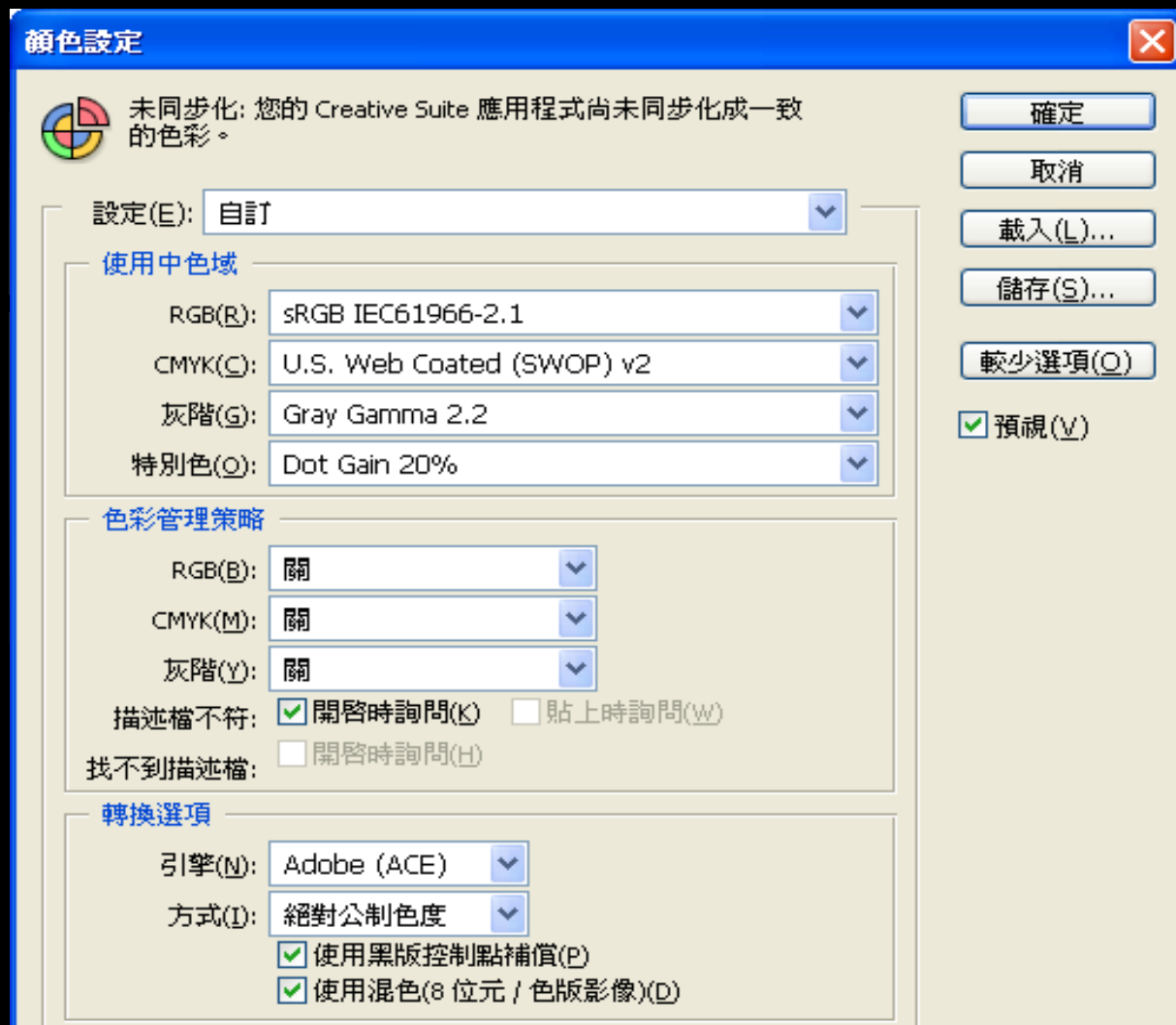
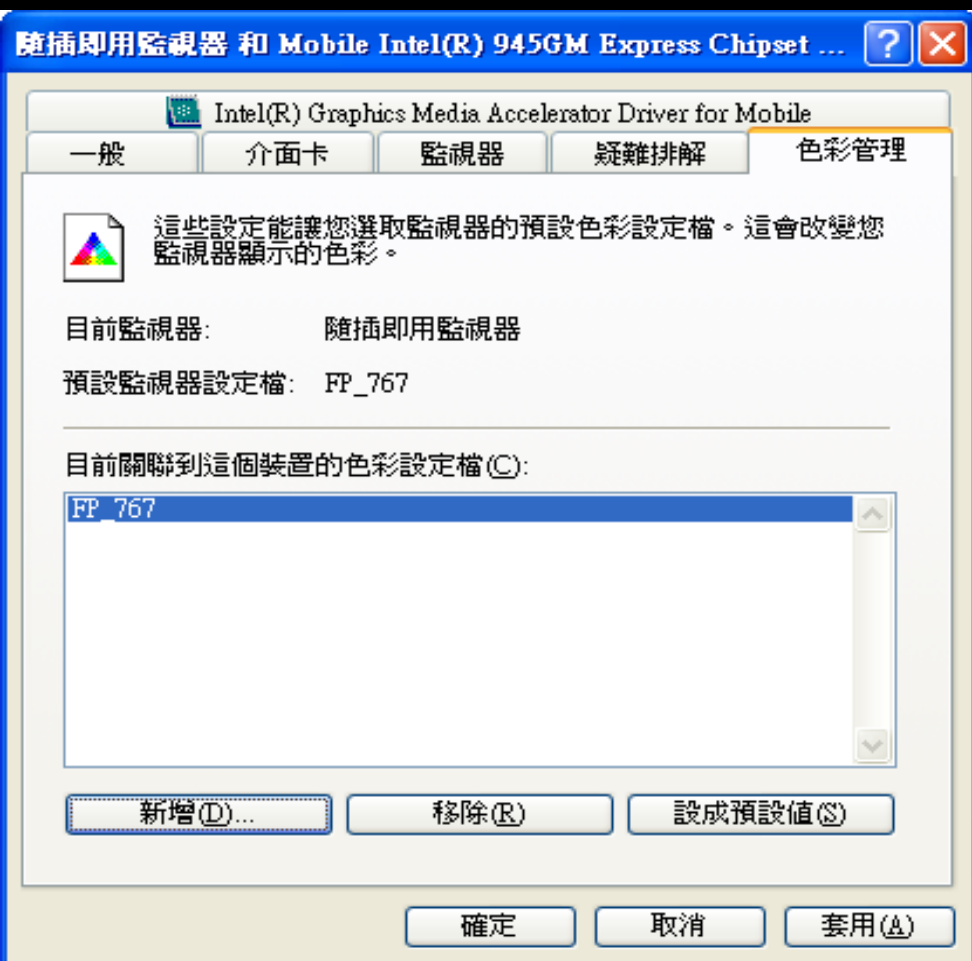
✓ 設定結果:
(171,48,60)



✓ (158,36,49)
on BenQ FP767

Demo #1: 豬年卡片

✓ 軟體數據與硬體顯色::系統與應用程式



Demo #1: 豬年卡片

✓ 軟體數據與硬體顯色::系統與應用程式

- ✓ 當系統色彩管理不做設定，WinXP 內定系統顯色空間為sRGB
- ✓ Photoshop 內定色彩空間為sRGB
- ✓ 顯示設備是否符合sRGB???
 - ✓ 如果顯示設備符合sRGB，Photoshop RGB 即可代表正確色彩...(EIZO ColorEdge CG211 NT\$90K, BenQ FP91R NT40k)
 - ✓ 若顯示設備未符合sRGB，將WinXP系統顯色空間設定為顯示設備 icc Profile，將有助於正確顯示色彩；Photoshop 會參考系統色彩空間宣告與 Photoshop色彩空間宣告改變色彩顯示

Demo #1: 豬年卡片 on sRGB

- ✓ **sRGB**: standard RGB
- ✓ 1996年由Microsoft & HP 提出
- ✓ 白點(x_W, y_W)=(0.31,0.33), D65
- ✓ $R(x_R, y_R)=(0.64, 0.33)$, $G(x_G, y_G)=(0.30, 0.60)$,
 $B(x_B, y_B)=(0.15, 0.06)$ 。
- ✓ Gamma=2.2
- ✓ 顯示器輝度:80 cd/m²

Digital Darkroom Spec.

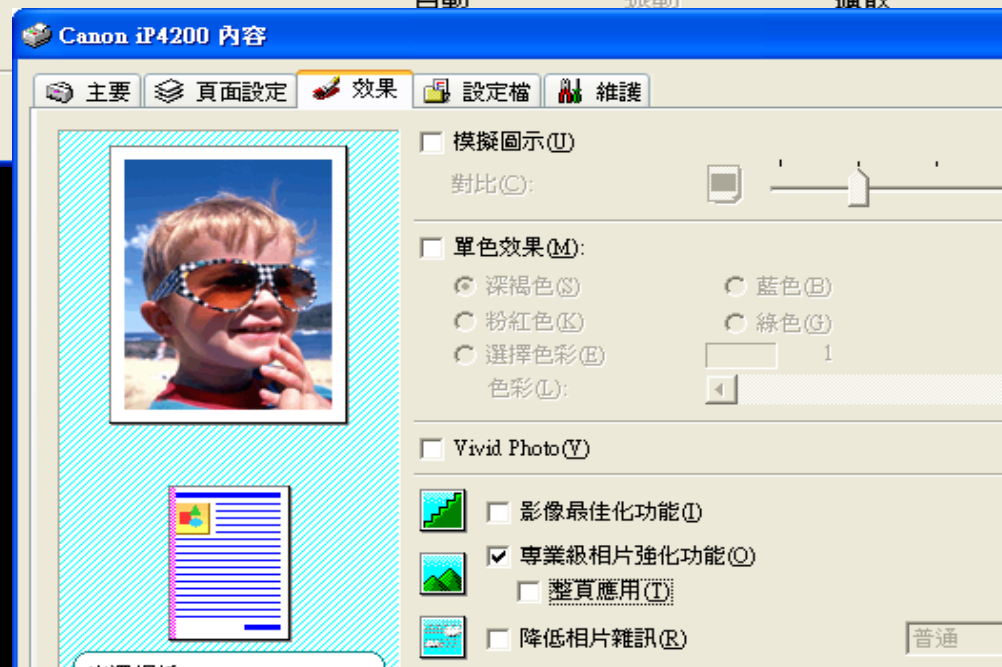
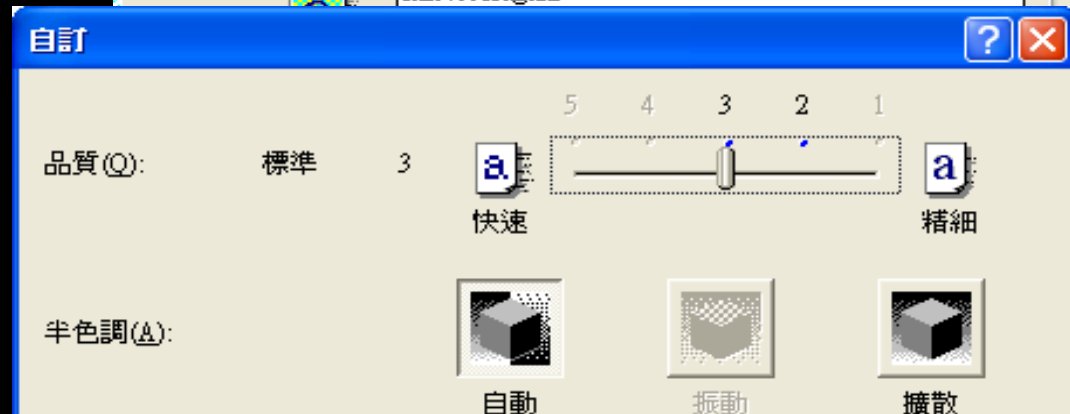
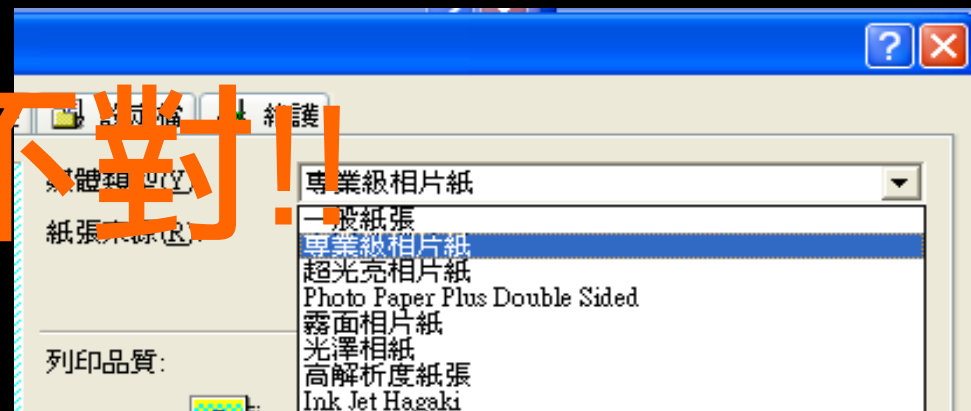
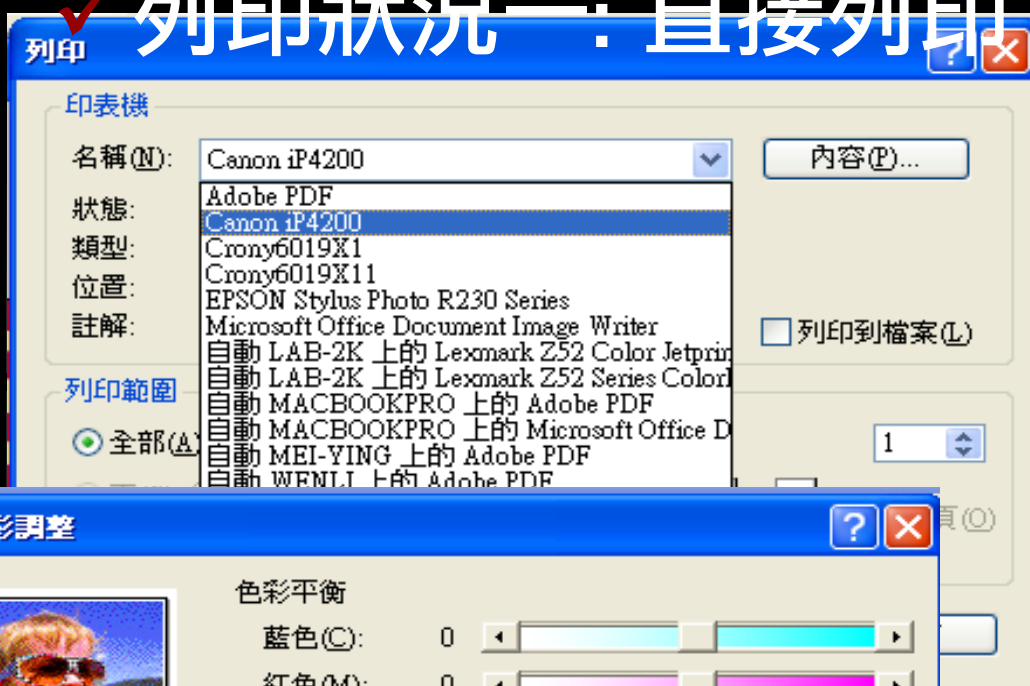
Key Issues	ISO 3664 If digital images are to be edited on a display, Independent of printed output	ISO 12646 If digital images are to be edited on a display, and compared to printed output
REFERENCE ILLUMINANT	CIE D50	CIE D50
D50 COLOR RENDERING INDEX	90 or higher	90 or higher
D50 METAMERISM INDEX	Less than 4	Less than 4
AMBIENT LIGHT (White Point)	CIE D50 (5,000K or less, Not all 5,000K lamps are D50)	CIE D50 (5,000K or less, Not all 5,000K lamps are D50)
AMBIENT LIGHT (Editing Areas)	64 to 32 lux (or lower)	32 lux (or lower)
AMBIENT LIGHT (Proofing Areas)	1,500 to 2,500 lux	1,500 to 2,500 lux
AMBIENT LIGHT (Extraneous)	Baffle from all widows, point sources, etc.	Baffle from all widows, point sources, etc.
AMBIENT LIGHT (Glare)	No reflections on monitors	No reflections on monitors
Monitor (White Point)	CIE D65	CIE D50
Monitor (White Luminance)	75 cd/m ² to 100 cd/m ²	80 cd/m ² to 120 cd/m ²
Environmental Surfaces	Color-neutral surfaces; Walls 60% reflectance or less	Color-neutral surfaces; Walls 60% reflectance or less
Maintenance	Regularly test all devices for adherence to specifications	Regularly test all devices for adherence to specifications



列印端問題

Help!! 怎麼印都不對!!

✓ 列印狀況一：直接列印



Help!!: 怎麼印都不對!!

✓ 直接列印

✓ 列印結果:

✓ 數據參考:

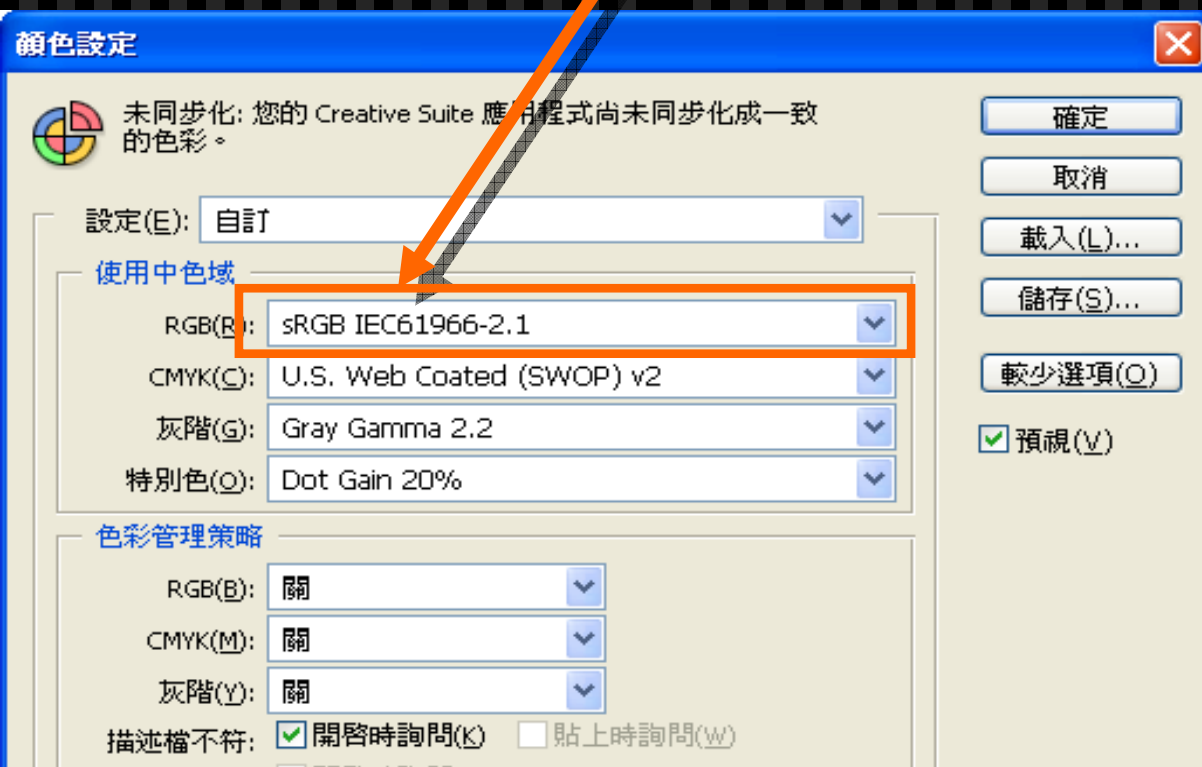
LCD測量	列印測量	ΔE_{94}
44.6, 52.2, 0.5	48.5, 33.7, 17.2	12.8
35.4, 54.1, 3.3	44.4, 34.5, 21.8	16.2



Help!!! 怎麼印都不對!!

✓ 列印狀況二: icc列印

工作空間宣告



列印空間宣告

Help!!: 怎麼印都不對!!

✓ icc列印

✓ 列印結果:

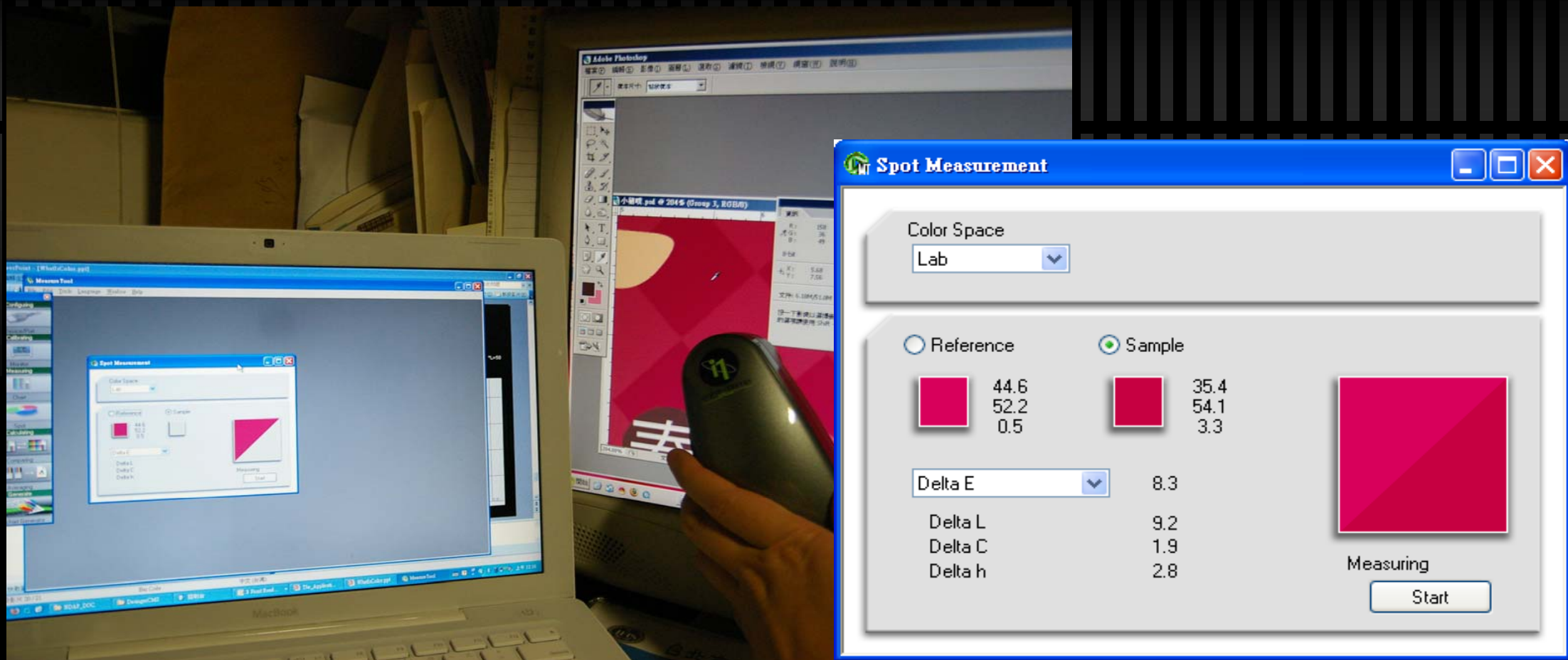
✓ 數據參考:

LCD測量	列印測量	ΔE_{94}
44.6, 52.2, 0.5	41.17, 48.8, 18.8	11
35.4, 54.1, 3.3	36.3, 49.5, 20.8	10



Help!!! 怎麼印都不對!!

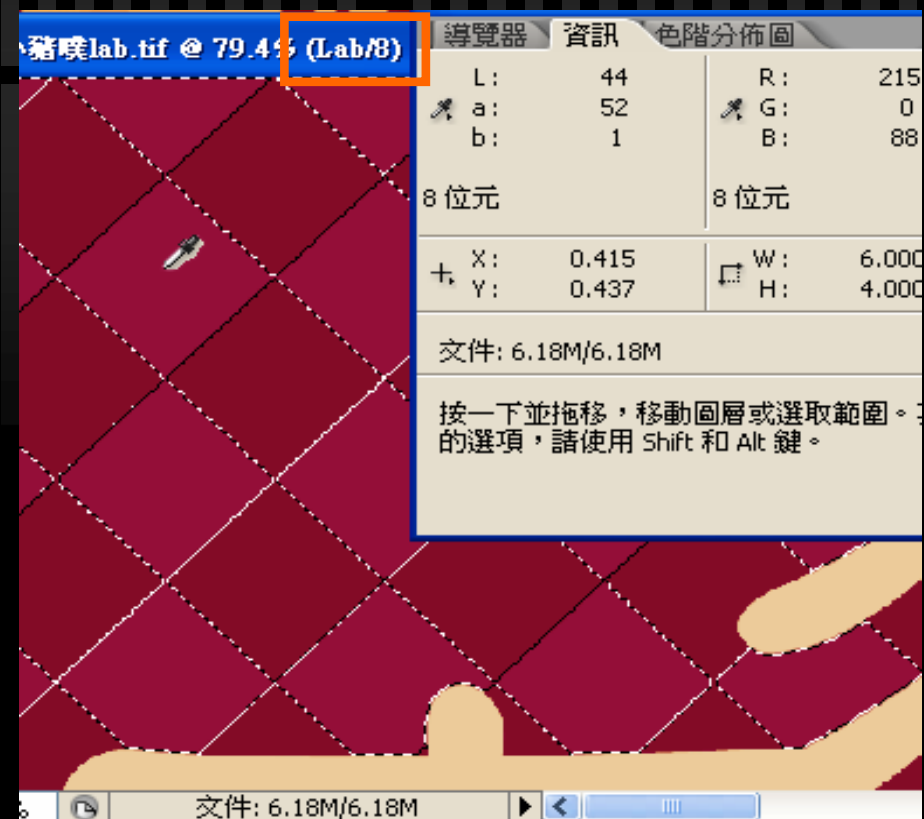
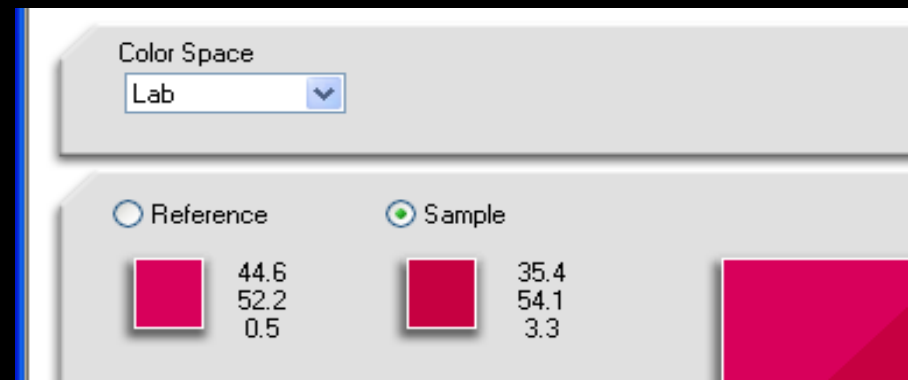
✓ 列印狀況三: Lab列印
✓ 實際從LCD測得Lab值



Help!!!: 怎麼印都不對!!

✓ 列印狀況三: Lab列印

- ✓ 於Photoshop 將RGB轉為Lab Mode
- ✓ 在Lab mode 下直接將色塊指定Lab數值



Help!!: 怎麼印都不對!!

- ✓ 列印狀況三: Lab 列印
- ✓ 於 Lab mode 下直接列印

列印空間宣告



Help!!: 怎麼印都不對!!

✓ Lab列印

✓ 列印結果:

✓ 數據參考:

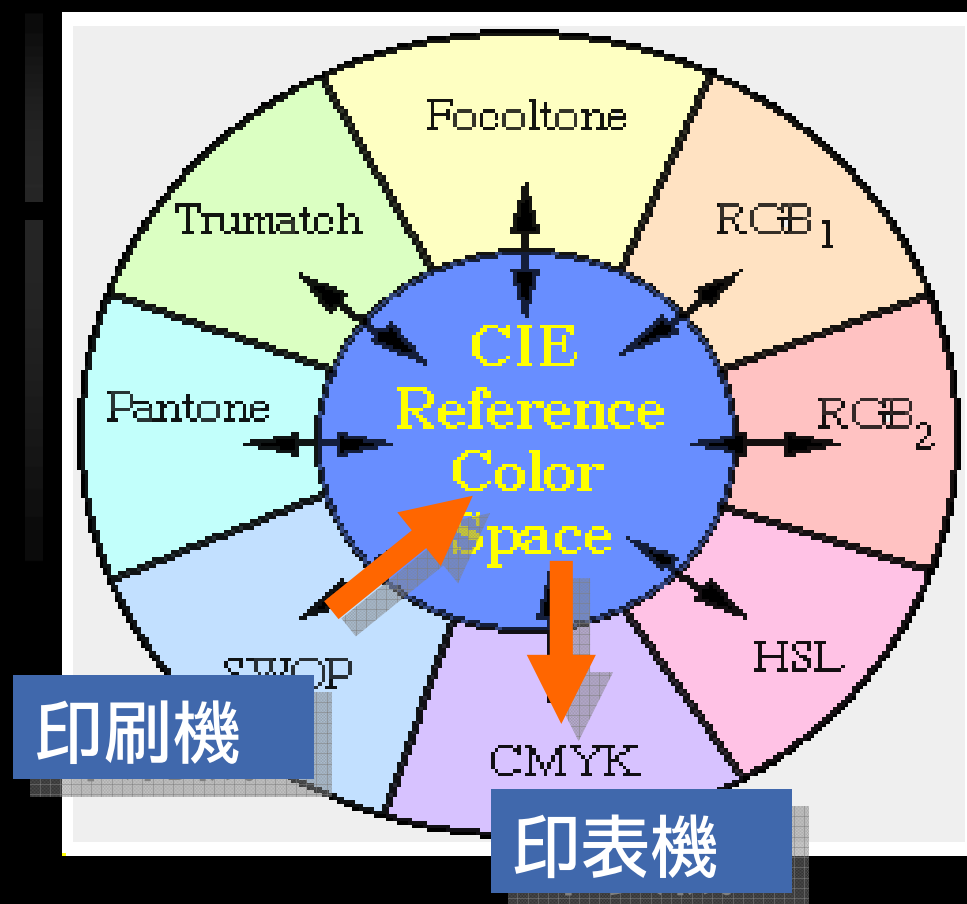
LCD測量	列印測量	ΔE_{94}
44.6, 52.2, 0.5	43.3, 54.7, 2.07	1.72
35.4, 54.1, 3.3	37.4, 55.9, 1.37	2.33





Desinger's Demo #2: 數位打樣

CMS application(打樣)



印研中心ISO 12647-2 打樣認證產品

- ✓ 機型名稱Epson 10600
- ✓ RIP名稱Oris 5.1.2
- ✓ 材料名稱紙張－EP510；墨水－T5491-6
- ✓ 機型名稱Epson 9600
- ✓ RIP名稱GMG 4.1.04
- ✓ 材料名稱紙張－EP515；墨水－T5441-7
- ✓ 機型名稱Epson 9800
- ✓ RIP名稱Express Compose RIP 7.0
- ✓ 材料名稱紙張－EP510；墨水－T5631-37、T5639
- ✓ 機型名稱Epson 9800
- ✓ RIP名稱EFI XF 3.0 Version
- ✓ 材料名稱紙張－EP515；墨水－K3T5631~5639

ISO 12647-2

- ✓ 2004 年 ISO 發表12647(1-5) 系列文件，針對各種印刷方式提出測量，材料，色彩，控制等各方面規範; 其中12647-2為針對平版張頁機之規範
- ✓ 其中色彩部份使用ECI 2002 年 1485 個樣本為色彩標準
- ✓ 印研中心採用ECI2002 1485個色塊作為數位樣認證參考
- ✓ 印研中心數位樣認證標準為ECI2002 1485個色塊，最大色差不超過 $6 \Delta E$, 平均色差不超過 $2 \Delta E$ (**Max $\Delta E \leq 6$, Avg $\Delta E \leq 2$**)

Desinger's Demo #2: 數位打樣

✓ 12647-2 數位樣認證成本:

RIP(200K and up) + 快速量測系統 (200K) + Epson
UltraChrome 大噴(200K) = 600K and up

✓ 小噴怎麼玩?!

Desinger's Demo #2: 數位打樣

- ✓ 取得印刷機端 icc profile (標準 profile 如 12647-2 或 實際印刷機 profile)



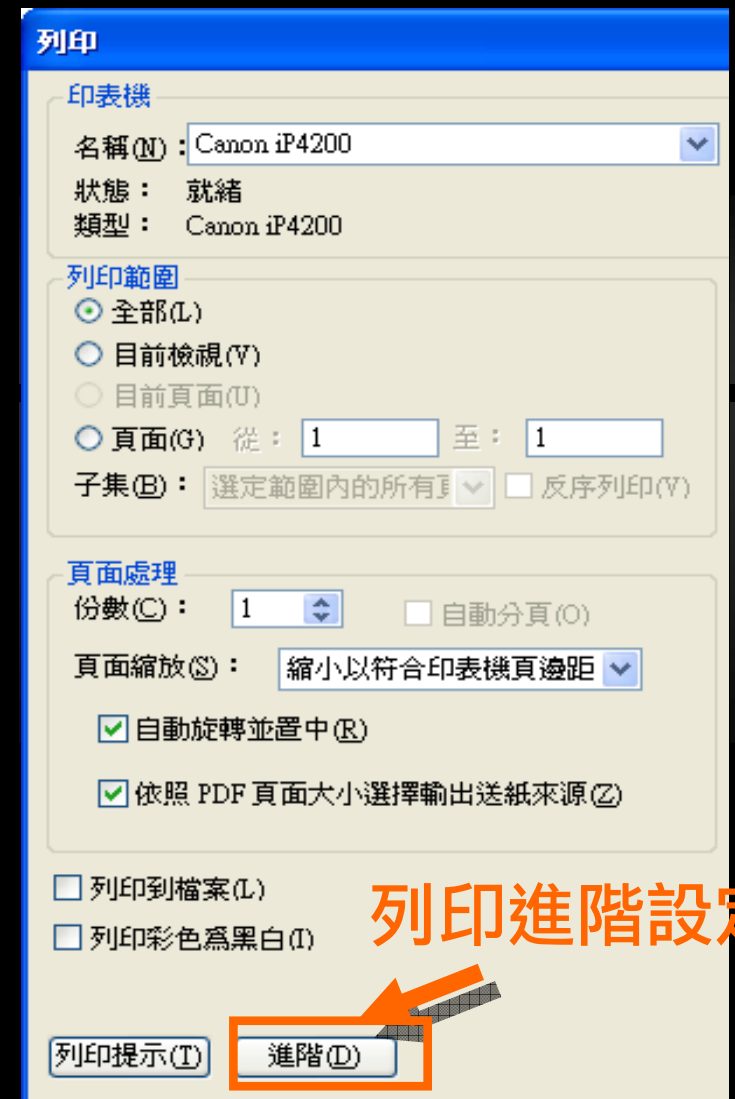
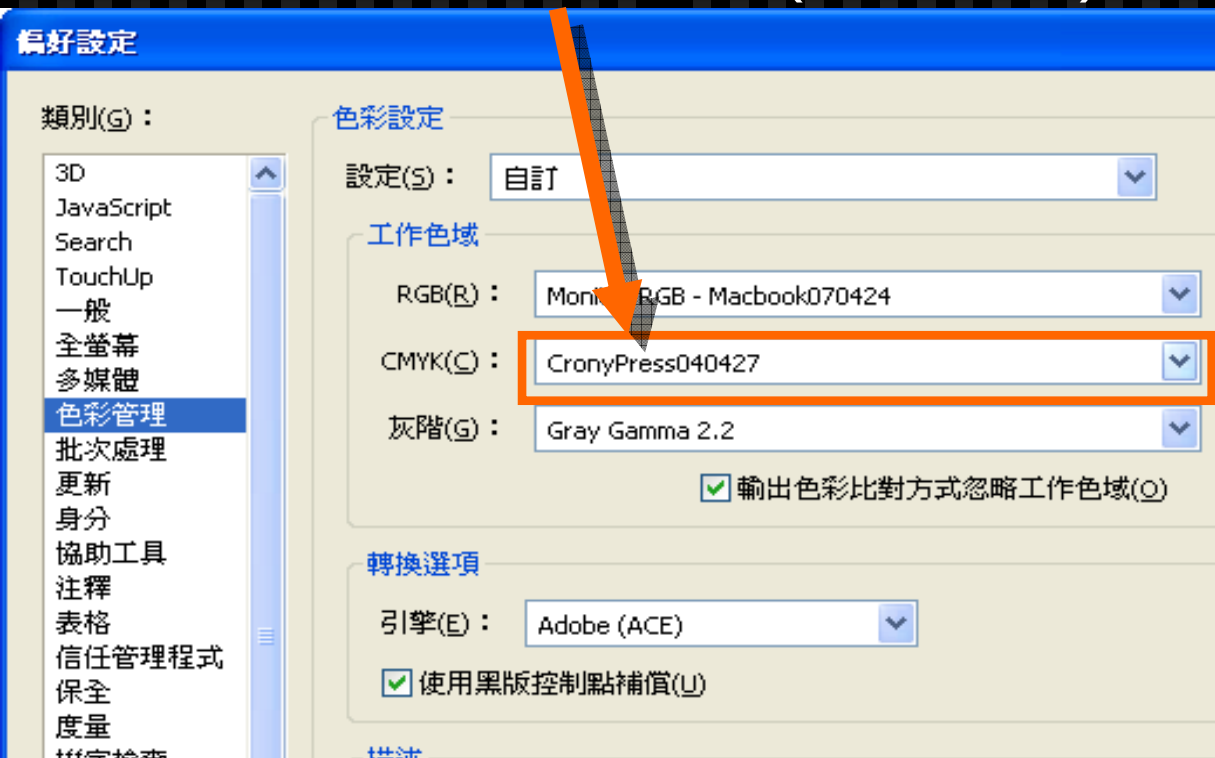
Desinger's Demo #2: 數位打樣

✓ 取得印表機端 icc profile



Desinger's Demo #2: 數位打樣

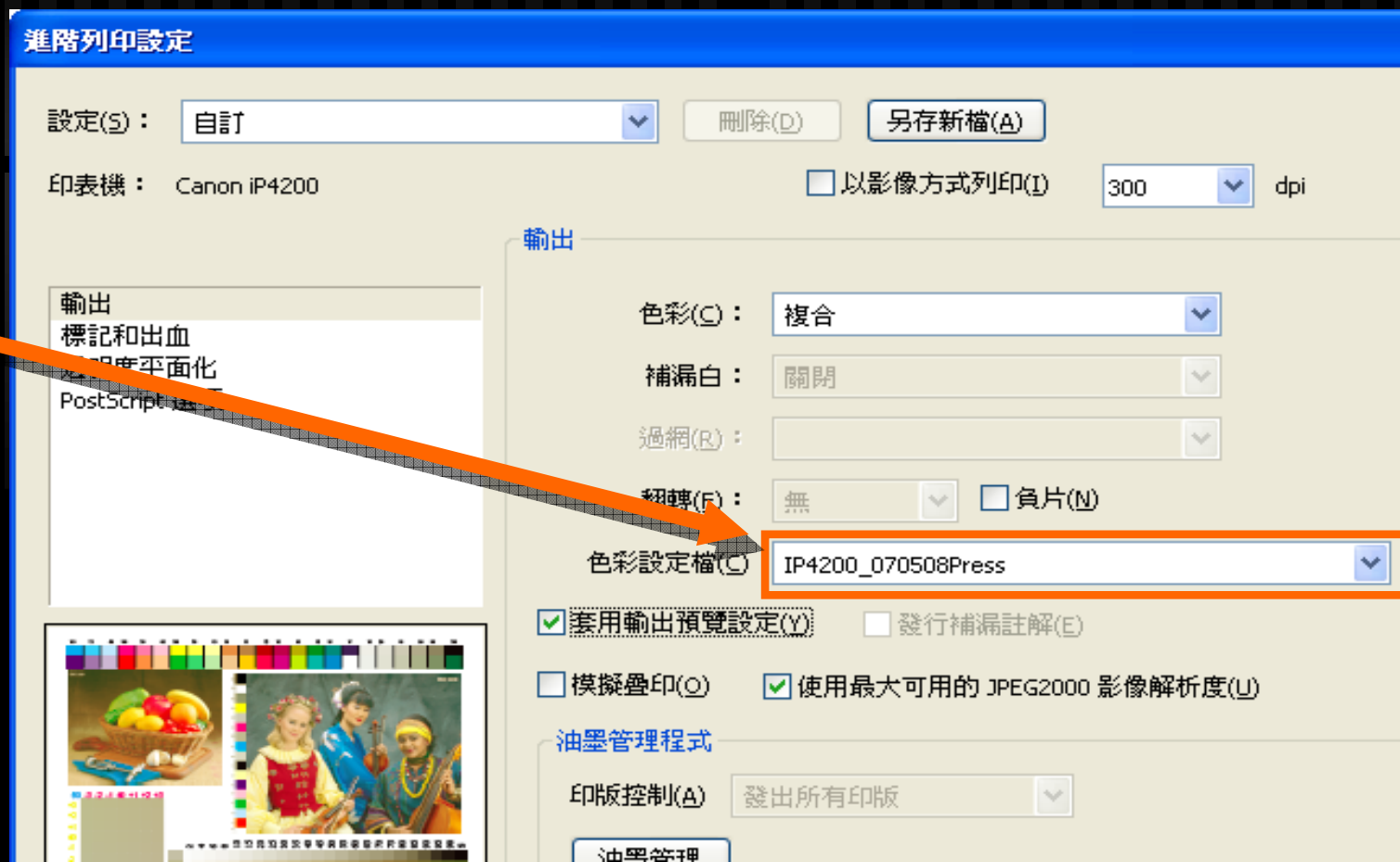
✓ Acrobat icc 列印示範 定義印刷機空間 (來源空間)



Desinger's Demo #2: 數位打樣

✓ Acrobat icc 列印示範

定義印表機空間



Desinger's Demo #2: 數位打樣

✓ Acrobat icc
列印示範

No CMS

Summary:

Category	Check for	dE	Result
Paper white	<=3.00	1.30	OK
Mean dE	<=4.00	5.35	not OK
Max dE	<=10.00	14.49	not OK
Primary C	<=5.00	3.04	OK
Primary M	<=5.00	11.23	not OK
Primary Y	<=5.00	10.04	not OK
Primary K	<=5.00	4.69	OK

>> The analysed FOGRA media wedge measurement data is NOT within standard ! <<

Summary:

Category	Check for	dE	Result
Paper white	<=3.00	0.51	OK
Mean dE	<=4.00	15.15	not OK
Max dE	<=10.00	57.10	not OK
Primary C	<=5.00	35.17	not OK
Primary M	<=5.00	11.57	not OK
Primary Y	<=5.00	20.33	not OK
Primary K	<=5.00	11.17	not OK

>> The analysed FOGRA media wedge measurement data is NOT within standard ! <<

With CMS, 平均色
差改善 10 ΔE

總結:



- ✓ 色彩溝通與傳遞的理論基礎及應用工具已驅完備
- ✓ 施行成本仍然偏高
- ✓ 色彩相關設備的規格化有助於降低使用者進入CMS的門檻
- ✓ 色彩相關設備的規格化有助於相關業者發展應用CMS產品的門檻
- ✓ 正確的色彩管理運作確實有效的降低色彩溝通問題進而節省人力消耗時間消耗及材料消耗
- ✓ 期待更平易近人的運作成本及操作工具