



Impact of ECG on PDF Publication

Does “N” Mean “No”?

William Li, Colour Products Manager, Kodak



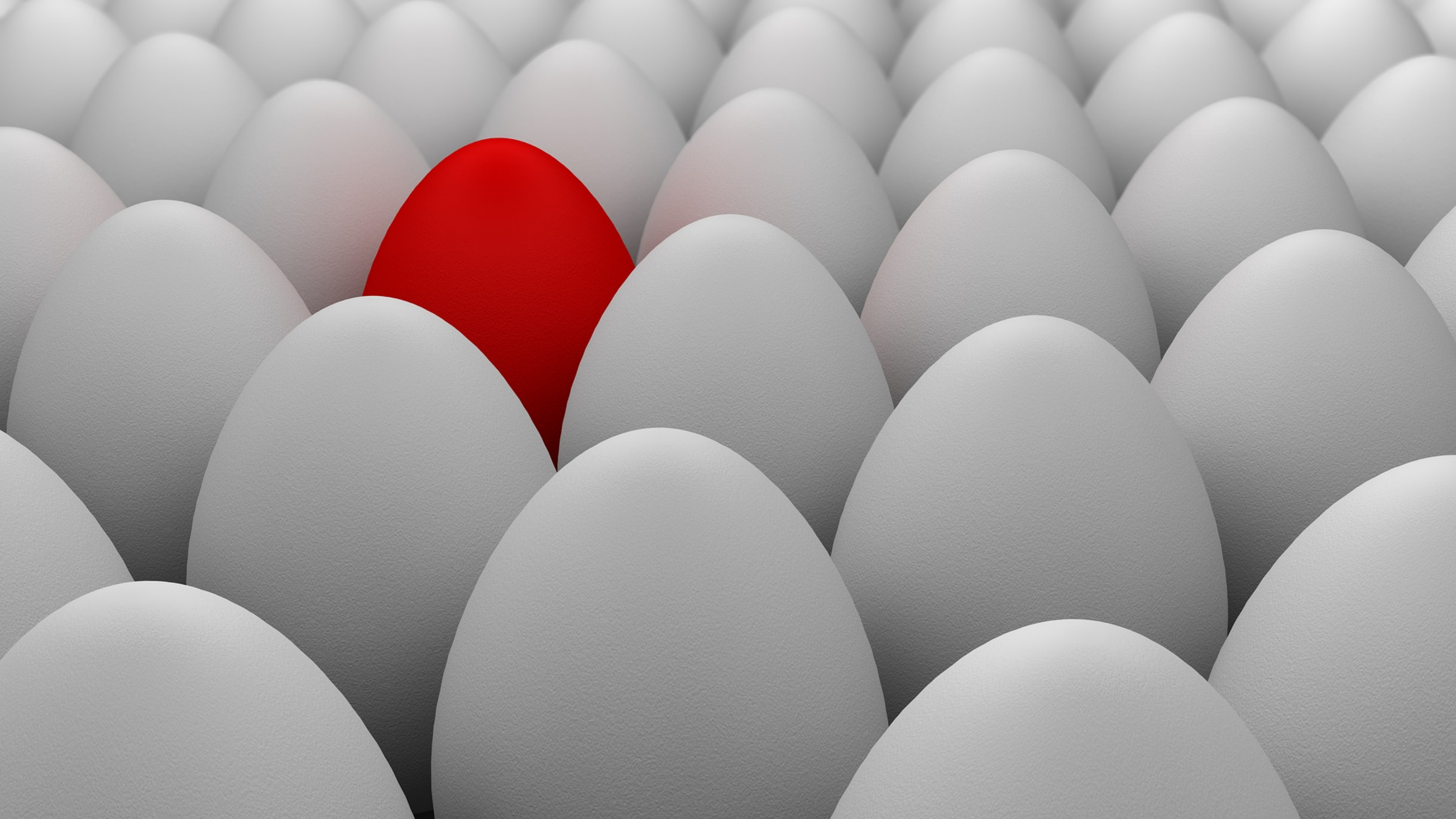
Making Time for N

- Extended Colour Gamut printing

Extended Colour Gamut Printing

Doing More With N





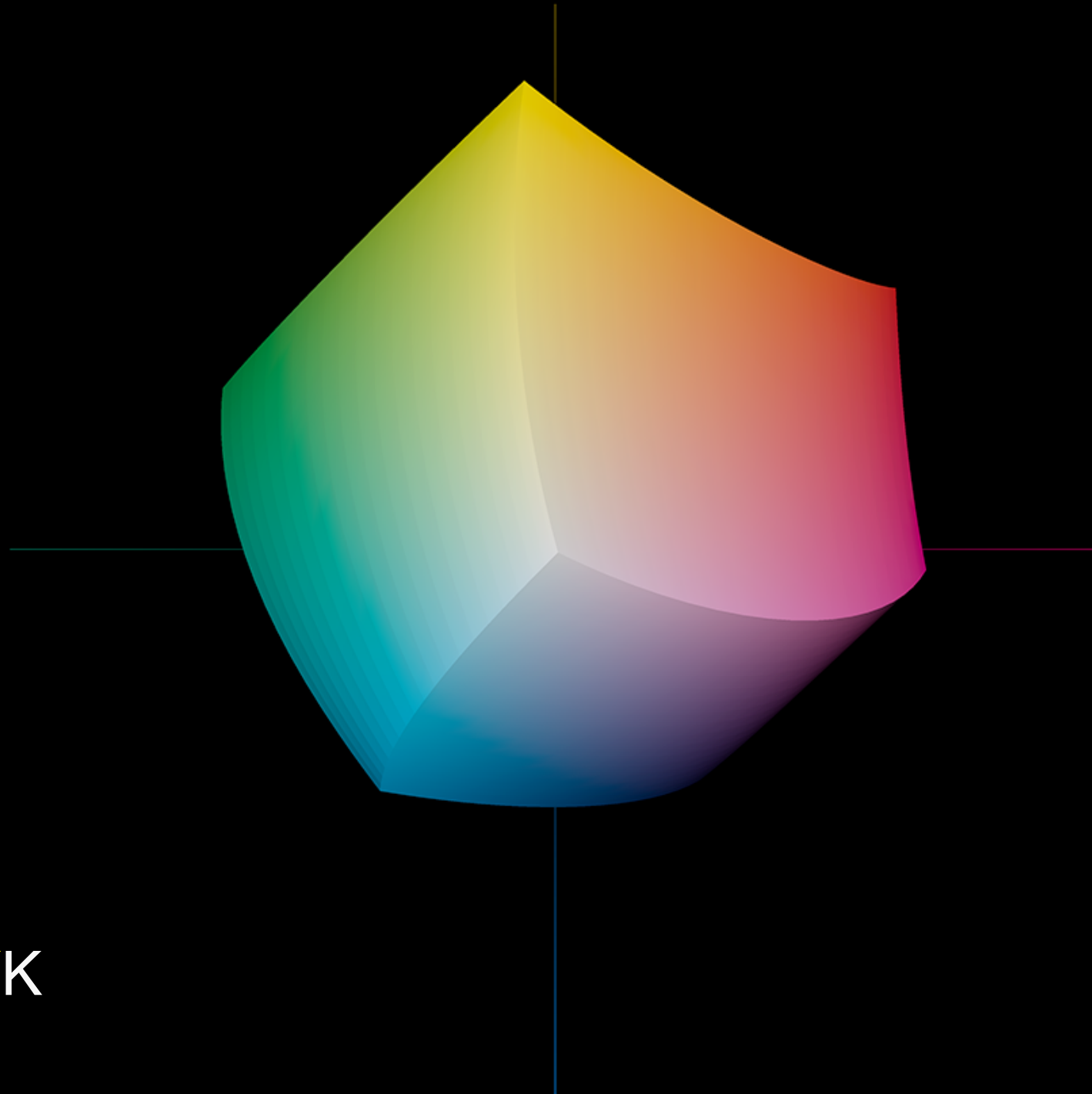


What is ECG?

- Printing with > 4 colours as part of process
- In PDF context, equivalent to DeviceN, rather than Separation colour space:
 - Channels designed to overprint to create other colours.
- > CMYK used to reach greater colour gamut in subtractive colour system.

Choosing Inks

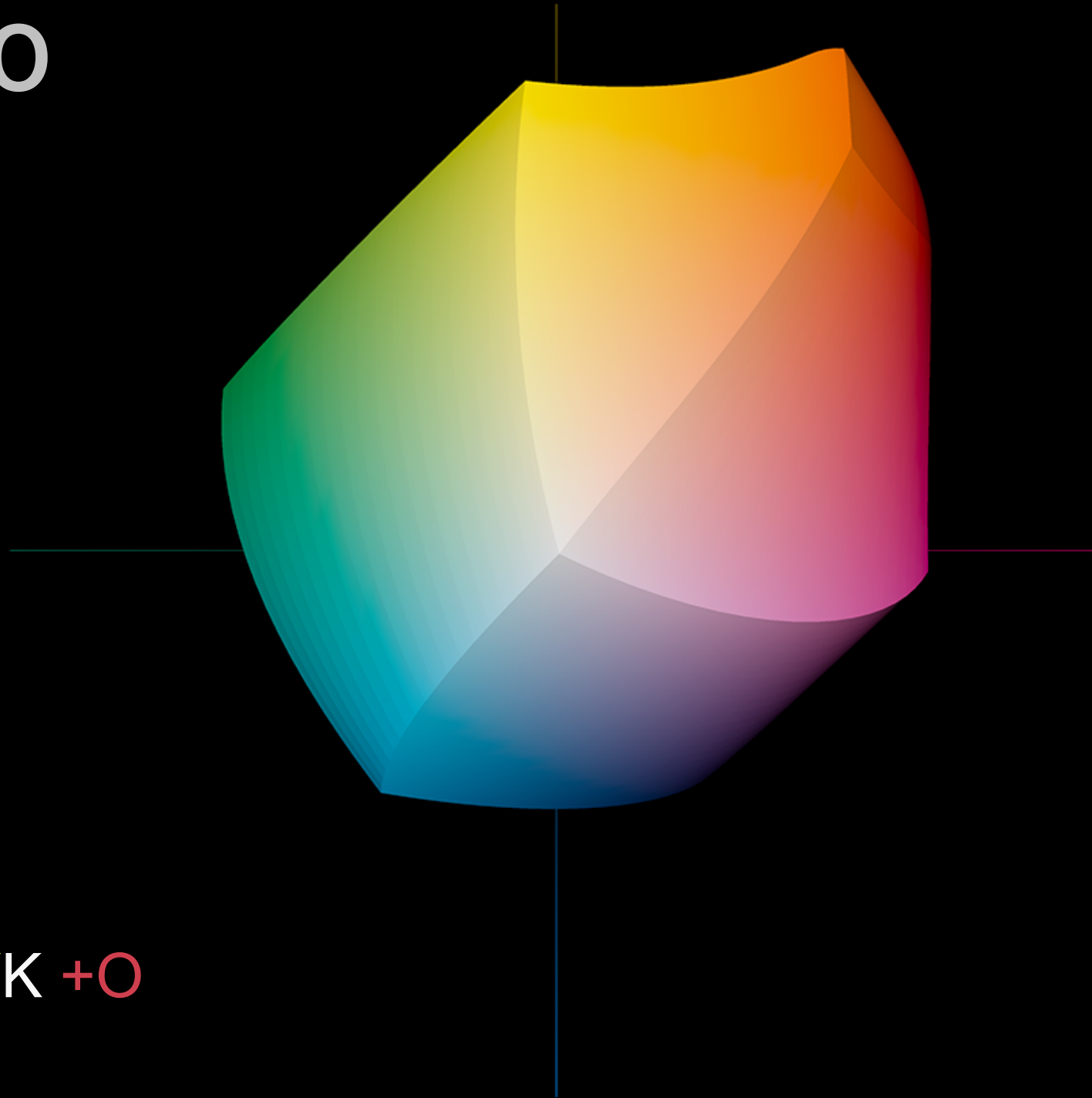
CMYK



CMYK

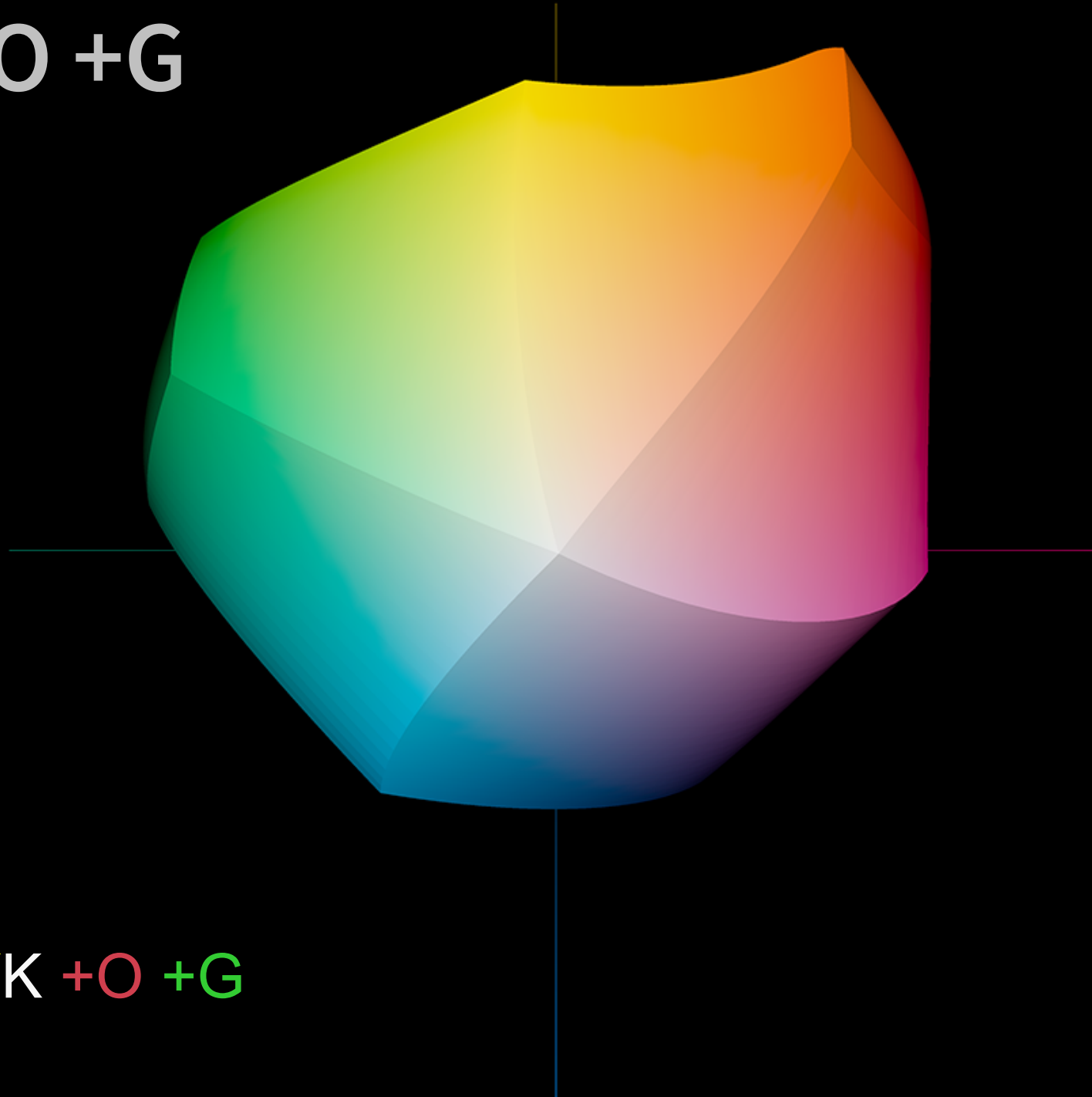
Choosing Inks

CMYK +O



Choosing Inks

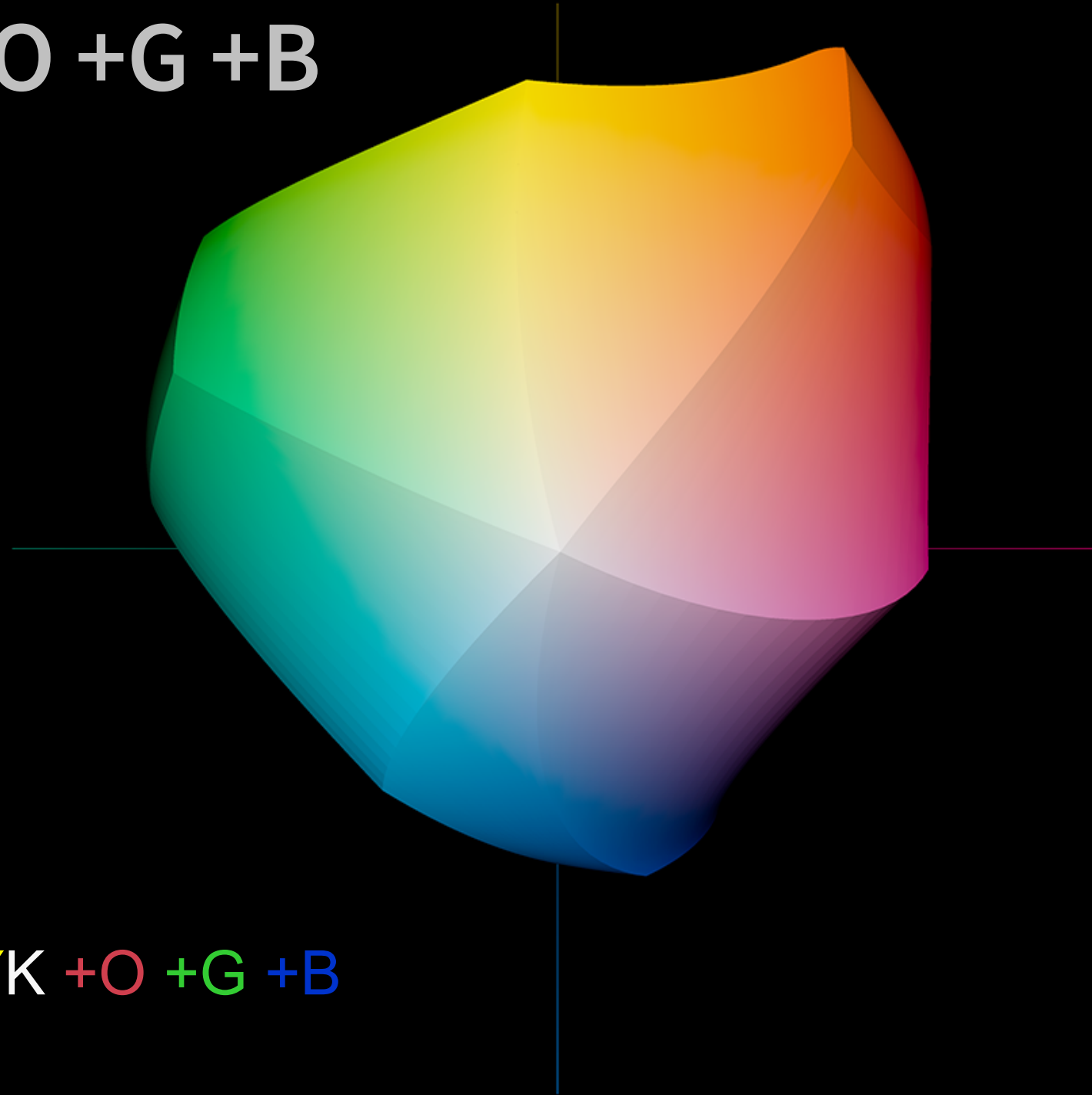
CMYK +O +G



CMYK +O +G

Choosing Inks

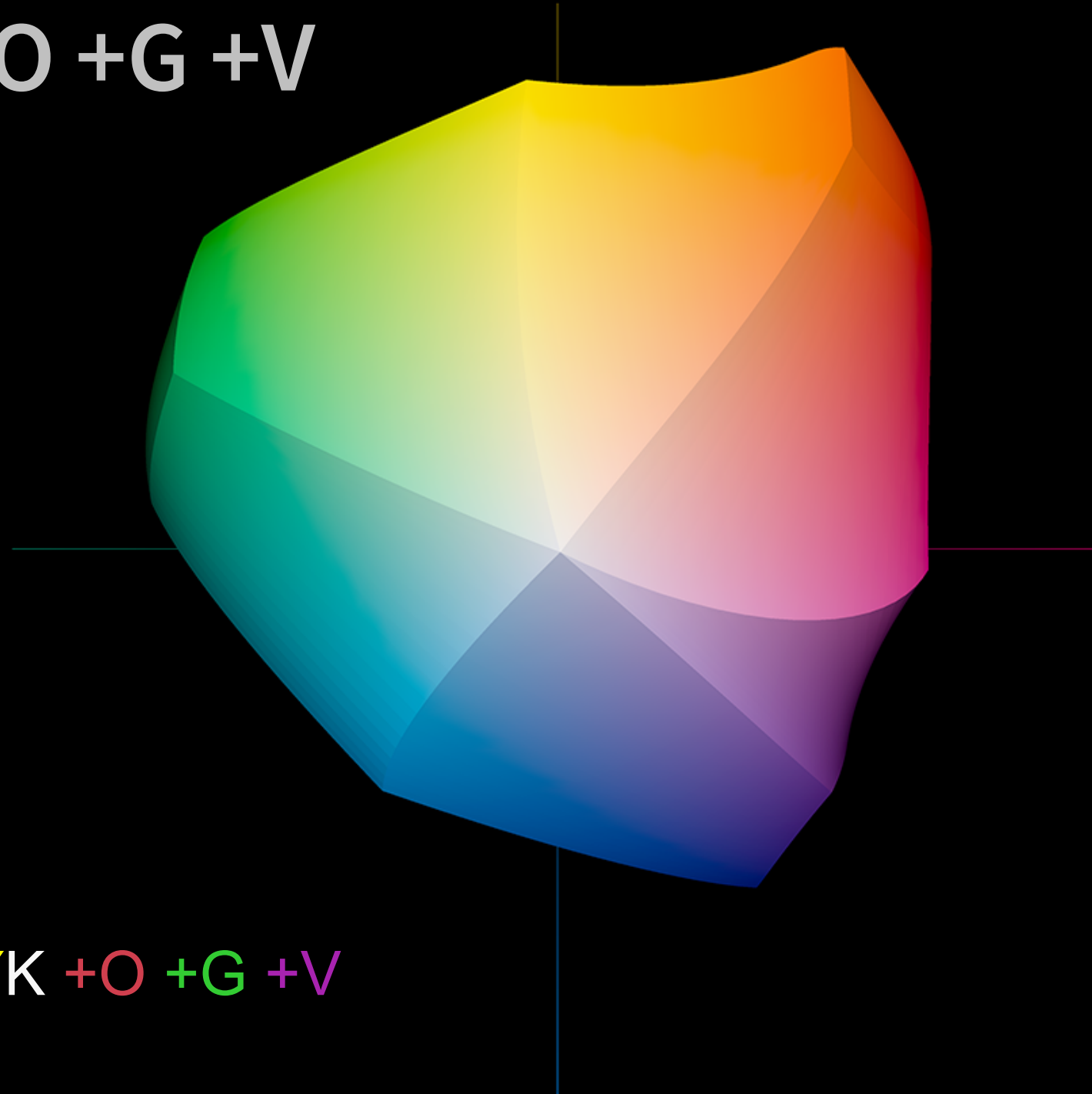
CMYK +O +G +B



CMYK +O +G +B

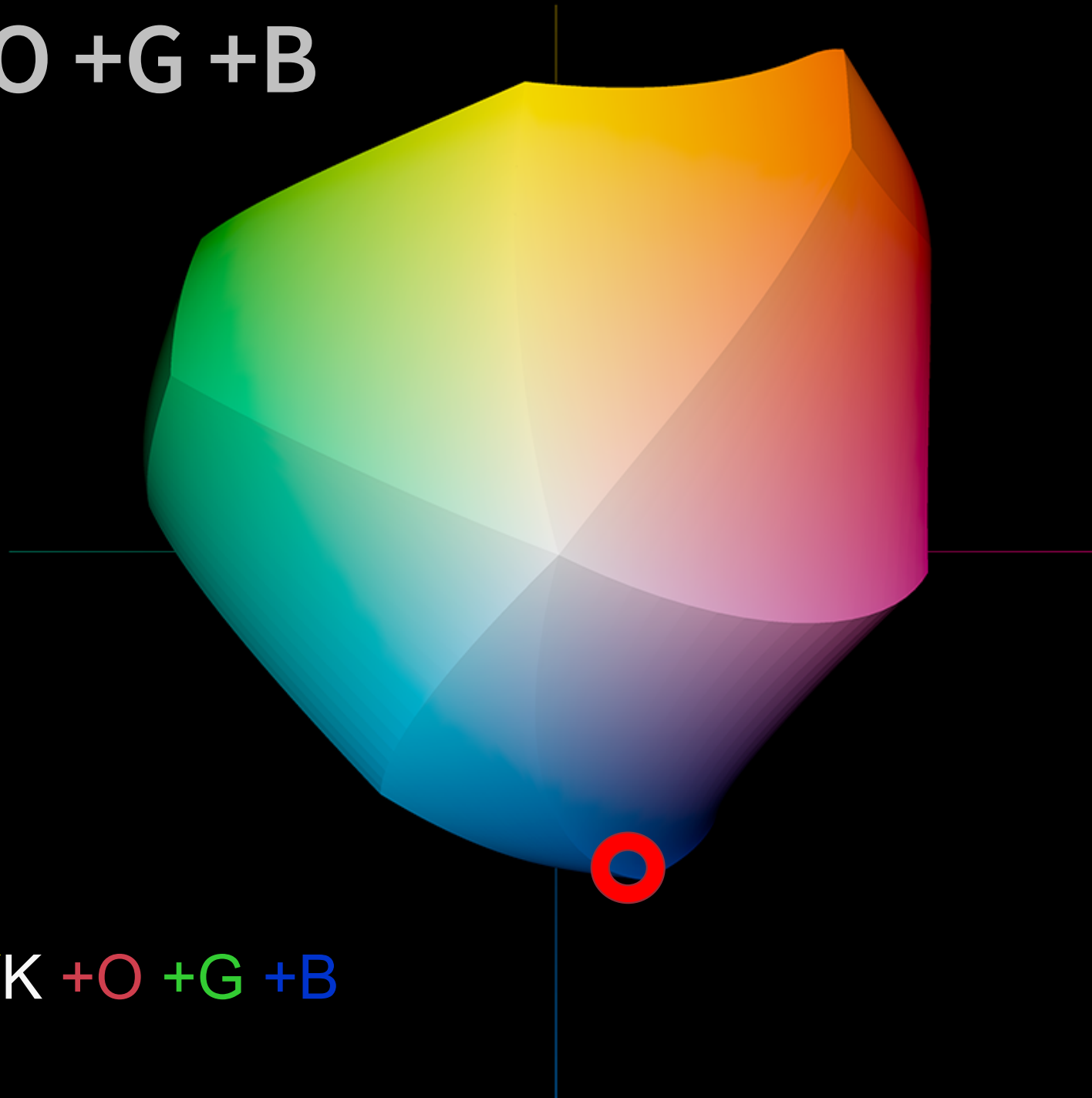
Choosing Inks

CMYK +O +G +V



Choosing Inks

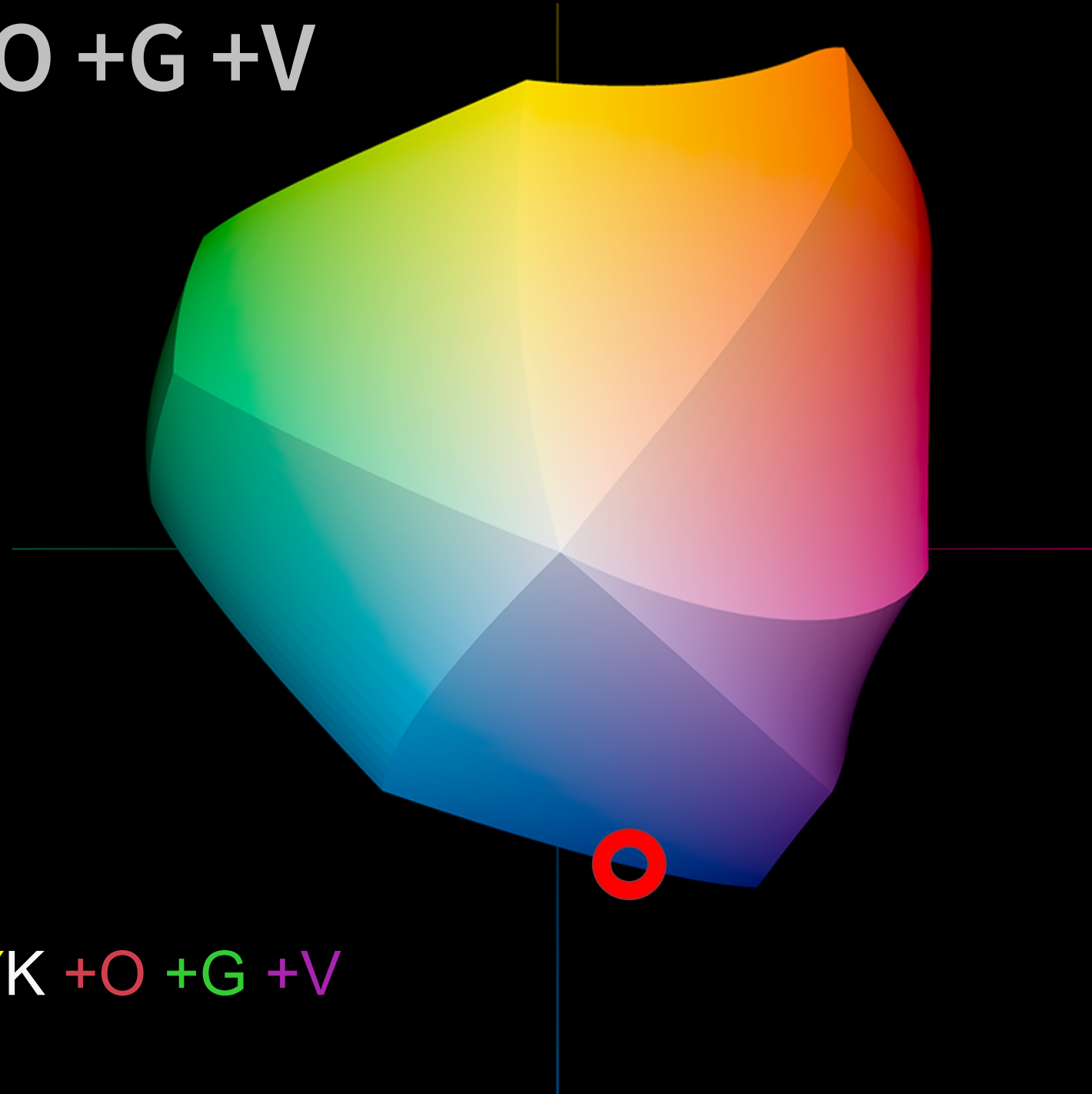
CMYK +O +G +B



CMYK +O +G +B

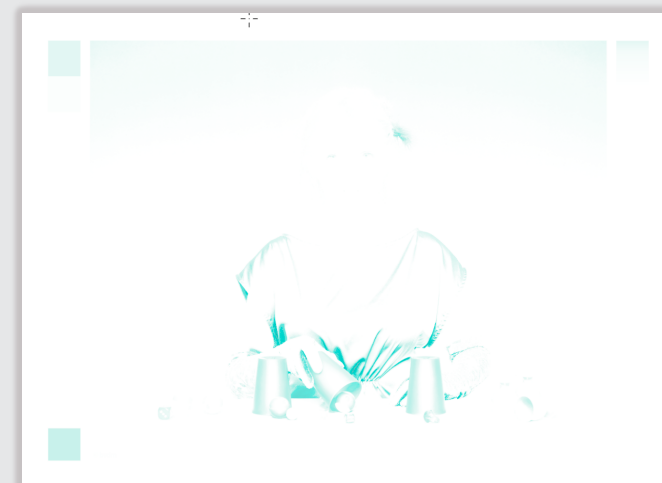
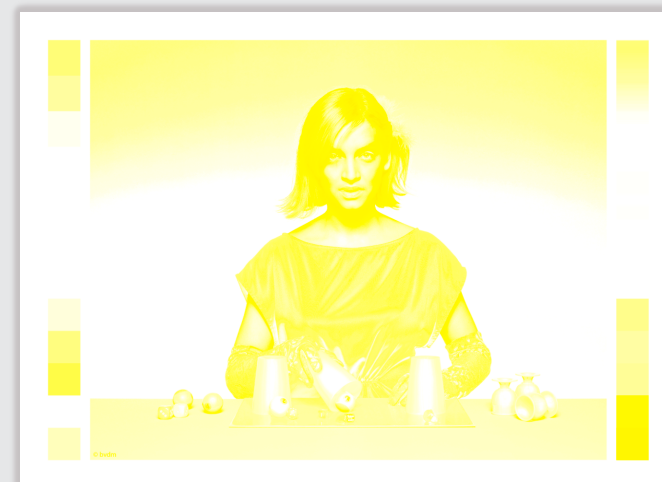
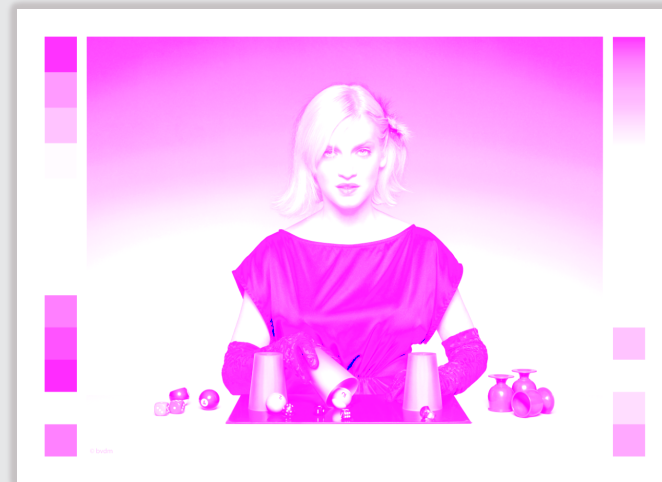
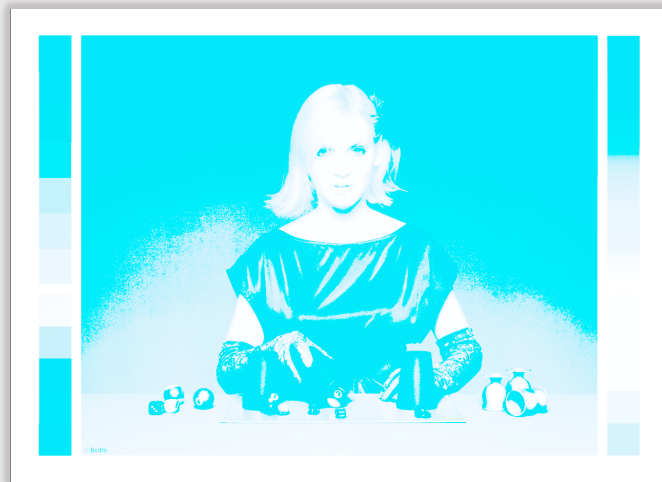
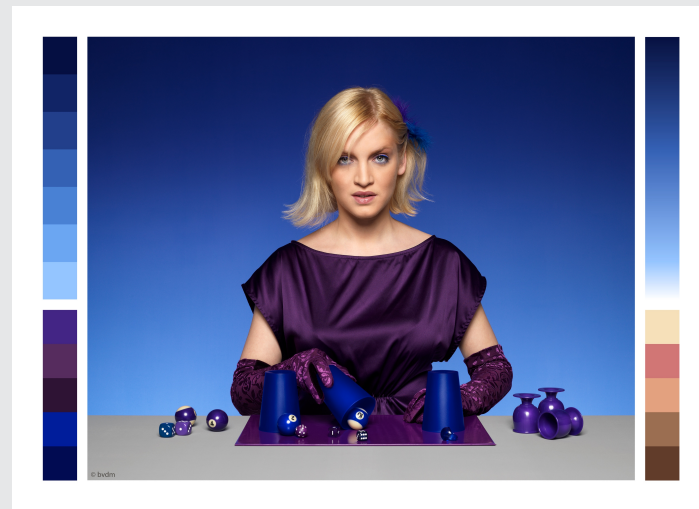
Choosing Inks

CMYK +O +G +V



CMYK +O +G +V





Colour Matters

- Note difficulty with correctly rendering the previous 7-colour slide in RGB medium (PowerPoint via PDF).
 - Complicated workflow, and results are not quite right.
 - No way to do copy-clipboard-paste or even Picture-import.

N-Colour Challenges

aka “Why this is difficult”

Challenge 0: Why ECG in PDF?

- Conventional PDF view considers that only appearance matters.
- Production requires that N-colour be part of model.
- Issue for transparency blend models, as transparency blend models are seriously curtailed for N-colour vs. those involving DeviceCMYK, DeviceRGB, etc.
- Users would like to have similar – consistent – behaviour for N-colour objects as for Gray, RGB, CMYK.
- Lack of similar behaviour is also one of the blockers for more widespread adoption of direct N-colour editing & creation tools.

Challenge 1: Transparency

Limited methods for handling transparency with N-colour.

- *“Although blending may also be done on individual spot colours specified in a Separation or DeviceN colour space, such colours shall not be converted to a blending colour space...”*
- **Separable** blending modes only (Multiply, Darken, etc.)
- Only on common colour components.

Challenge 2: No ICCBasedN

- No ability (within PDF) to embed colour of overprints inside PDF for N-colour constructs.
 - ICCBased colour space only supports:
 - Gray
 - RGB
 - CMYK
 - No ability to convert from N channels to PCS (CIE-based colorimetry).

Challenge 3: OutputIntent

- OutputIntent (used for PDF/X, where we really care about N) cannot be N-colour ICC profile in same way it can be a CMYK ICC profile.
 - Transparency
 - Embedding

N-Colour Proposal

ICC to the Rescue?

Proposal: ICCBasedN

- ICCBasedN resolves many of the issues, provided we limit applicability in rendering model.
- General idea is:
 1. Enable “ICCBasedN” colour space.
 2. Use ICCBasedN colour space in same fashion as one uses ICCBased1, 3, 4 when resolving transparency stacks.

Blend Rule Precepts

- Conversion to/from N-colour requires ICC profile. ie, mainly concerned about ICCBasedN, not DeviceN.
- Rules such as §11.7.2, para 5 (use of nearest ancestor to facilitate conversion into CIE-based colour space if none locally available) can be used.
- In principle, we could do the same for DeviceN, but this is logistically much more complicated because of the larger variety of possible DeviceN spaces. Probably better to use the more commercially, practically useful ICCBasedN.



Source = Background = Blending colour space

■ Separable:

- Essentially same as existing ISO 32000-2. (per, eg, §11.3.4 para 5: complement, blend, then complement result) Blend per-channel using existing rules. No essential difference vs. order of operations in ISO 32000-2.
- Some minor specific language changes needed for correct interpretation for ICCBasedN case.

■ Non-separable:

- Essentially same as existing ISO 32000-2 EXCEPT:
- Use ICC transformation to convert source and background (already in blending colour space) from N-colour blending colour space to RGB, then follow the non-separable blend mode rules, then use ICC again to transform back from RGB to N-colour.
- *** Need to assume an RGB ICCBased colour space for this.



Source, Background $\neq$ Blending colour space

■ Separable:

1. Blending colour space = ICCBasedN

- Use ICC transform to convert from source, background colour spaces into (common) N-colour blending colour space, then do regular separable blend.
- This would be the rule even where the source/background colour space is just a *different* ICCBasedN than the blending ICCBasedN colour space.

2. Source and/or Background colour space = ICCBasedN

- Also use ICC transform to convert from source, background colour spaces into appropriate Gray, RGB, or CMYK (device) colour space for regular separable blending.
- Follow rules from eg, §11.7.2, to determine appropriate destination ICC transform. Same issue as before where a default destination ICC transform needs to be specified.



Source, Background $\neq$ Blending colour space

■ Non-Separable:

1. Blending colour space = ICCBasedN

- Use ICC transform to convert from source/background to N-colour space, then from N-colour to RGB for blending.
- After blending, ICC transform to convert from RGB to N-colour blending colour space.

2. Source and/or Background colour space = ICCBasedN, Blending colour space = Gray, RGB, CMYK

- Use ICC transform to convert from N-colour source/background to blending colour space (** §11.7.2 rules about obtaining other half of ICC transform also apply here)



Sample Evaluation Procedure

Examine combinations of following for source, background, and blending colour space:

- RGB: ICCBased (3), DeviceRGB
- CMYK: ICCBased (4), DeviceCMYK
- 7-colour: ICCBased (7)

CMYK, 7-c images for investigation generated via ICC profile pair transform:

- RGB: AdobeRGB1998.icc
- CMYK: GRACoL2013_CPRC6.icc
- 7c: Multicolour_7c_KCMYOGV.icc (non-standard – from offset press)



Samples



Source
Original: RGB
(pixabay)



Background
Original: RGB
(synthetic)

Sample Workflow

Source/background images initially consist of RGB pixels (TIFF).

For N-channel versions of the same images, use ICC transformation, via standard ICC profile pair (serial concatenation, RGB→7c).

Intended effect:

Using N-channel operations, transparency blend should look substantially similar (not necessarily identical) to equivalent CMYK-CMYK (subtractive space) transparency blend stack.





Multiply



Screen



Overlay



Darken



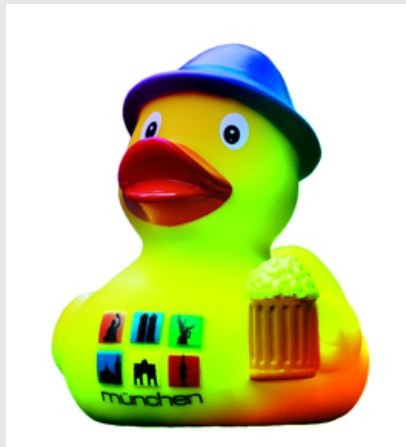
Lighten



ColorDodge



ColorBurn



HardLight



SoftLight



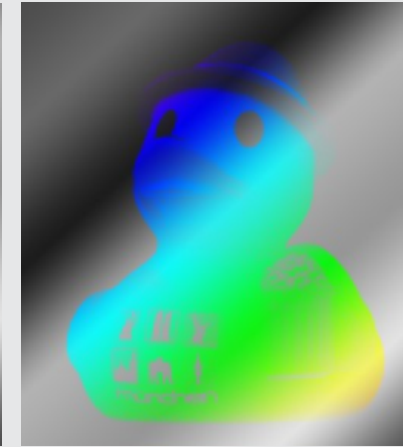
Difference



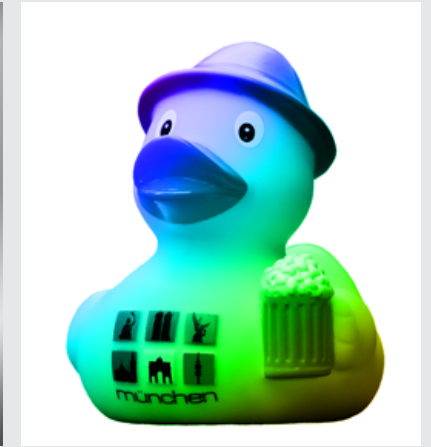
Exclusion



Hue



Saturation



Luminosity

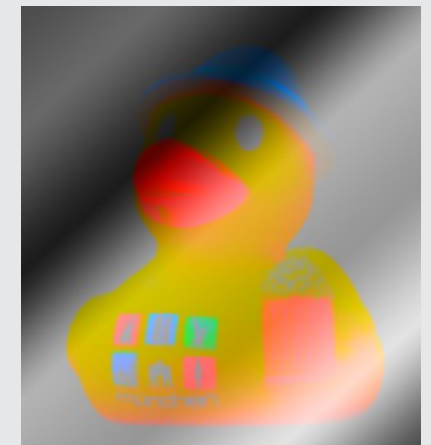
Source = Duck

Background = Rainbow

Source Colour Space = DeviceRGB

Background Colour Space = DeviceRGB

Blending Colour Space = DeviceRGB



Color



Multiply



Screen



Overlay



Darken



Lighten



ColorDodge



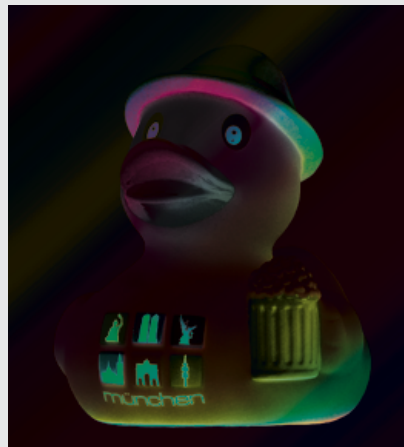
ColorBurn



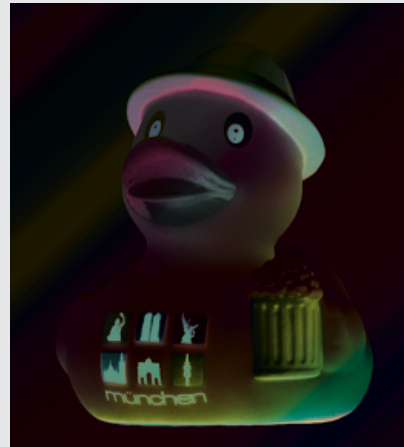
HardLight



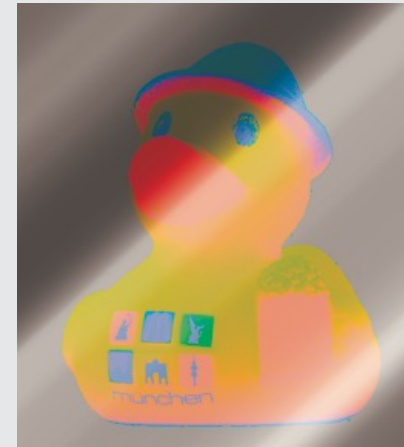
SoftLight



Difference



Exclusion



Hue



Saturation



Luminosity

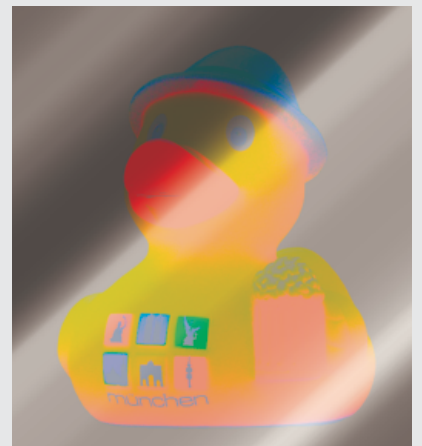
Source = Duck

Background = Rainbow

Source Colour Space = DeviceCMYK

Background Colour Space = DeviceCMYK

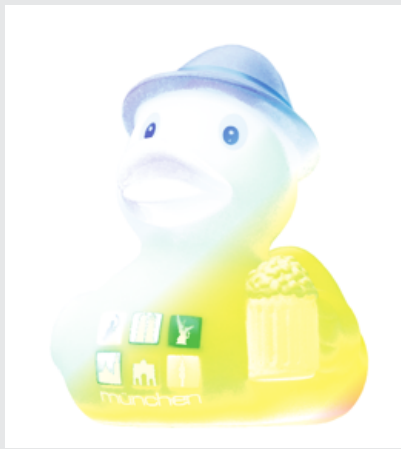
Blending Colour Space = DeviceCMYK



Color



Multiply



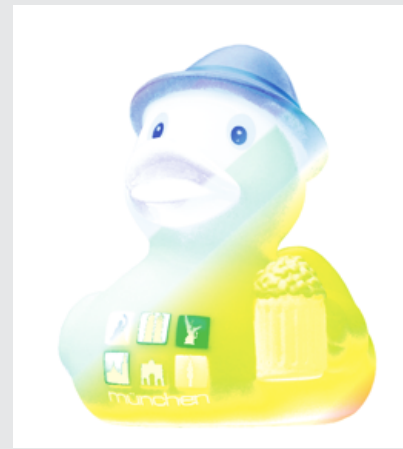
Screen



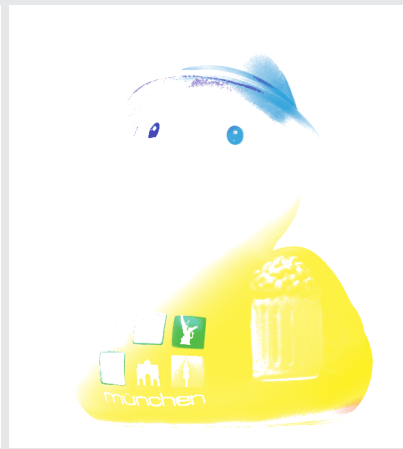
Overlay



Darken



Lighten



ColorDodge



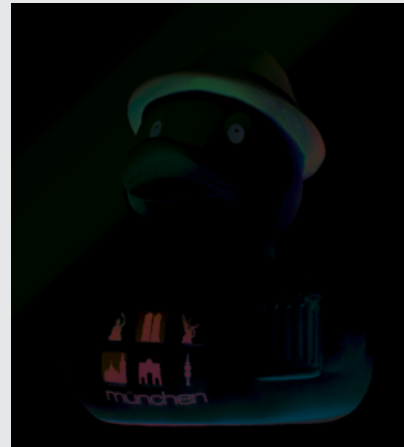
ColorBurn



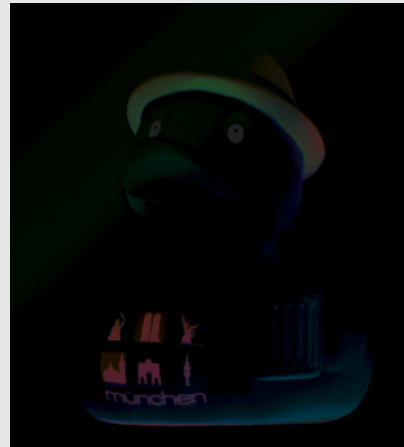
HardLight



SoftLight



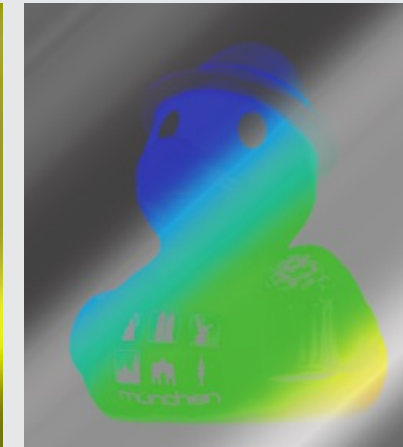
Difference



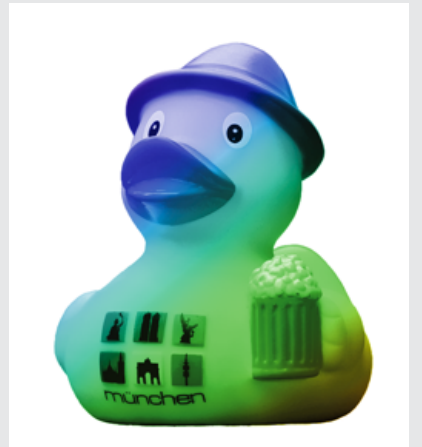
Exclusion



Hue



Saturation



Luminosity

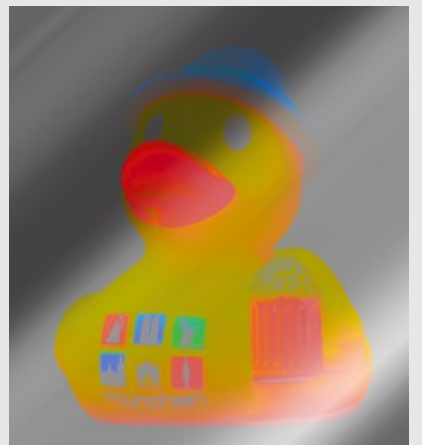
Source = Duck

Background = Rainbow

Source Colour Space = ICCBasedN (7c)

Background Colour Space = ICCBasedN (7c)

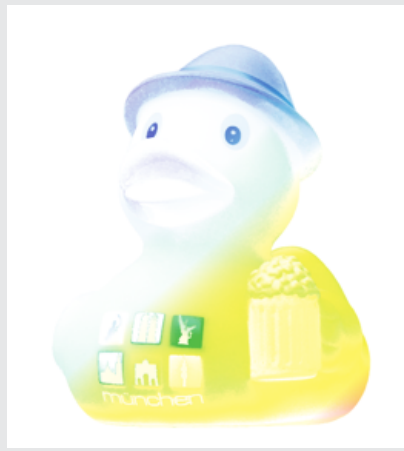
Blending Colour Space = ICCBasedN (7c)



Color



Multiply



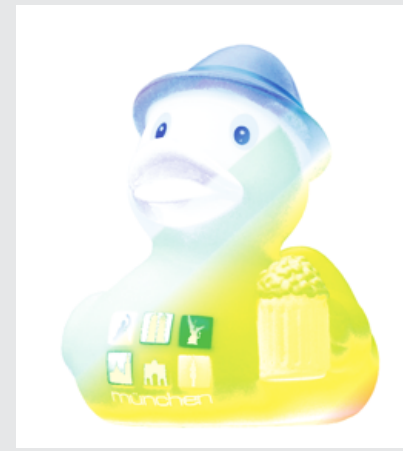
Screen



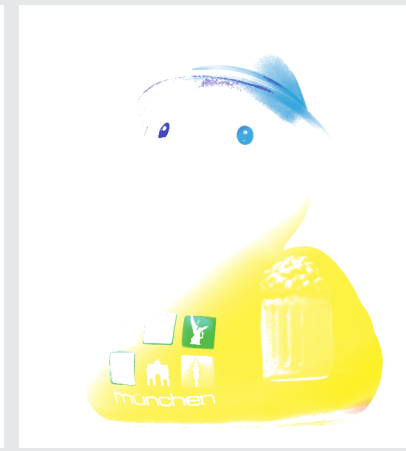
Overlay



Darken



Lighten



ColorDodge



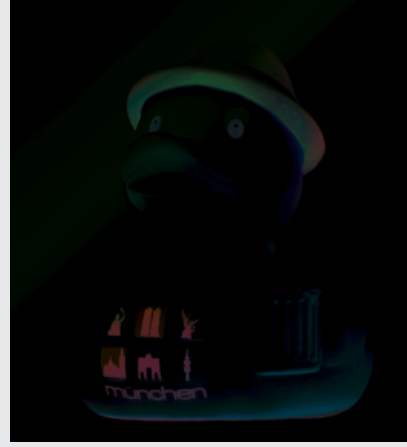
ColorBurn



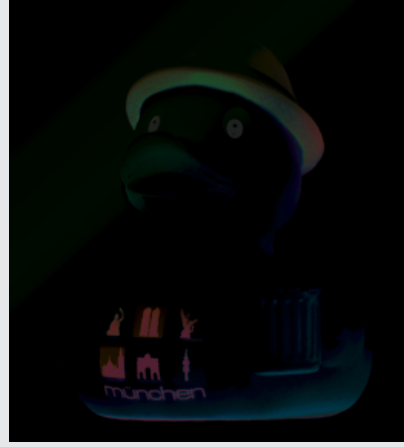
HardLight



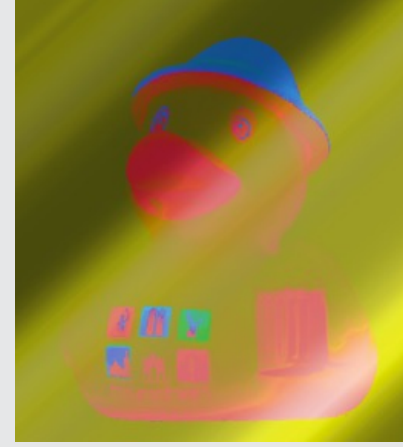
SoftLight



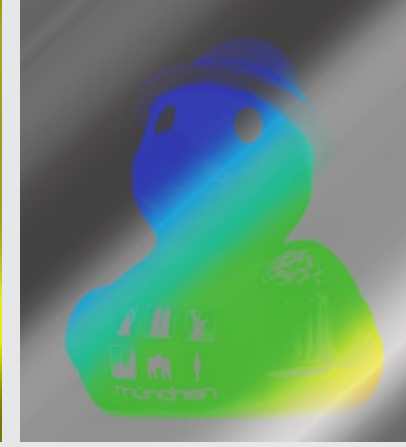
Difference



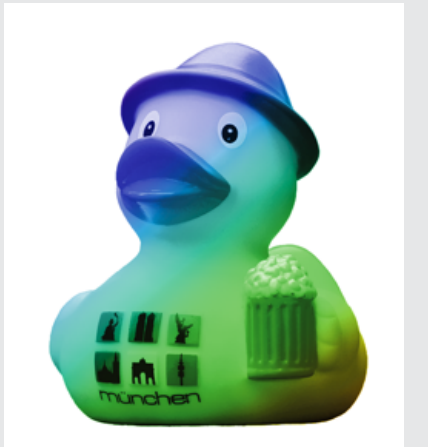
Exclusion



Hue



Saturation



Luminosity

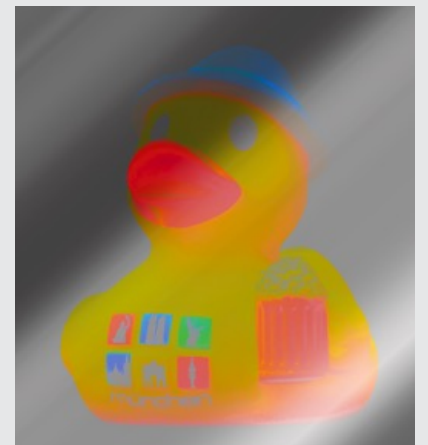
Source = Duck

Background = Rainbow

Source Colour Space = DeviceRGB

Background Colour Space = DeviceRGB

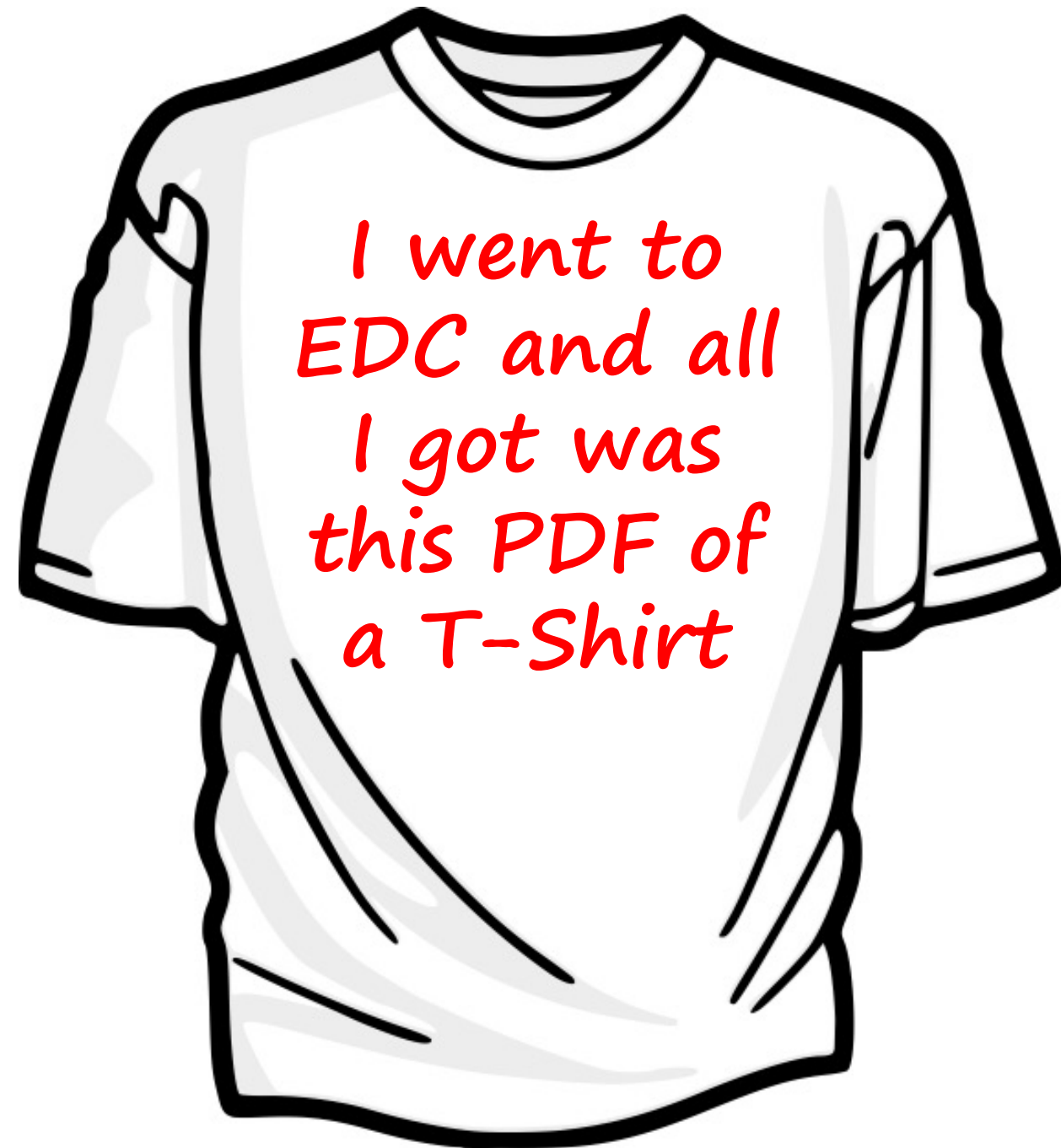
Blending Colour Space = ICCBasedN (7c)



Color

Discussion

- Gap discussion: details to be ironed out.
- What's next?



william.li@kodak.com