Josef Albers

"In visual perception a color is almost never seen as it really is – as it physically is. This fact makes color the most relative medium in art.

- Color is conditional.
- Color is relative.


Phenomena of Simultaneous Contrast

- “…Albers (1963) in…Interaction of Color, explores various aspects of simultaneous contrast and teaches artists and designers how to avoid the pitfalls and take advantage of the effects”
- Investigating Simultaneous Contrast can be traced to the work of Goethe and Chevreul, from the 1700’s and 1800’s


Simultaneous Contrast

- Albers wrote: "The fact that the after-image, or simultaneous contrast is a psycho-physical phenomenon should prove that no normal eye, not even the most trained one, is foolproof against color deception. He who claims to see colors independent of their illusionary changes fools only himself, and no one else” (p. 23)
- The phenomenon of Simultaneous Contrast permeates Albers’ illustrations in Interaction of Color.


Criteria of Simultaneous Contrast

- Adjacent color shift toward the complement of the other
- Mixed hues are more influenced than pure hue
- Dull colors change more easily than bright
- Light values are easier to change
- Strong contrast will create more extreme change
- Less contrast result in less change

Present Analysis

- Focus on Albers' Color Studies Curricula
  - Expressed in Interaction of Color
    - 1963 - Interaction of Color
      - Original, Landmark Edition
      - Over 250,000 sold
  - 2009 – New Complete Edition
    - "Brings (1963) Interaction back into classrooms, studios and onto bookshelves..."


Albers Curricula

- Albers contends that “art studies should be carried on in the laboratory than in the lecture room” (p.68).
- His methods are designed to help students with their constructive thinking
- Albers adopted Educational Philosopher John Dewey’s famous premise of “learning by doing”
  - Likely without direct knowledge of Dewey
- The pedagogical goal is for students to gain both knowledge and experience


Albers Curricula for Color Studies

- "Albers decided from the beginning that students would work with colored papers rather than with paint, and in that way, have a supply of consistent, ready-to-go colors” (p.21).
- In the early years of the course, students worked with colors they painted onto sheets of paper, and other papers from various sources

Source: Horowitz: Josef Albers : to Open Eyes : the Bauhaus, Black Mountain College, and Yale 2006

Albers Curricula: Color-Aid Papers

- In the late 1940s Albers began ordering packs of Color-Aid paper, which at the time contained more than two hundred six-by-nine inch-sheets of silk-screened papers.
- At Yale, he encouraged students to use other materials as well (though his assistants, aware of the need to have the right color at the right time, would quietly advise people to be sure they got the Color-Aid) p. 198

Source: Horowitz: Josef Albers : to Open Eyes : the Bauhaus, Black Mountain College, and Yale 2006

What is Color-Aid?

- Today, Color-Aid is a System of 314 colored papers
- Introduced in 1948
  - "Color-aid was soon thereafter discovered by Josef Albers and has since then become an indispensable teaching tool in art and design classes"

Source: Color-aid. https://coloraid.com
Present Analysis

- Albers’ Goals for Color Studies Curricula:
  - Simple and quick
  - Practical
  - Allow students to compare
  - More choices
  - Lower Cost
  - No influence of texture

- Today, with Interaction of Color (2009) and Color-Aid, together with modern color measurement tools, can other approaches achieve Albers’ pedagogical goals?

Discussion / Limitations

- Albers’ did not intend students to replicate his examples precisely
  - Hands’ on experimentation emphasized

- Approach provides a starting point
  - Two Colors as One
  - One Color as Two

- Currently, App Available

- Literature Review indicates no previous study examined using color measurement and color management tools applied to Albers’ curricula

General Model: Tools and Materials

- Interaction of Color (2009)
- Color-Aid Papers
- Spectrophotometers
- Software: ICC-Profiles, Database, Spreadsheet
- Inkjet Printer
- Soft Proofing
- Standardized Viewing Condition
- Information About Simultaneous Contrast

Two Approaches

Inkjet Printer Method

- What are the colorimetric limitations of using Photoshop and an inkjet printer in a color managed environment to replicate the “two colors as one” and “one color as two” from Interaction of Color?

Color-Aid Method

- What are the colorimetric limitations of using Color-Aid Papers to replicate the “two colors as one” and “one color as two” from Interaction of Color?

Inkjet Printer Method Limitations

- Photoshop Not Really a Scientific Colorimetric Tool:
  - No Illuminant/Observer
  - Whole numbers only

- No Raster Image Processor, Printer Driver Only
Materials (Inkjet Printer Method)

- Interaction of Color (2009)
- Software
  - Adobe Photoshop
  - X-Rite i1 Profiler software
- Color Measurement Tools: Spectrophotometers (X-Rite SpectroEye) and (X-Rite i1 Profiler/i1 Pro 2)
- Inkjet Printer: Epson Model SureColor P5000
- Standardized Viewing Condition
  - i1 Profiler Display
  - NEC PA242 Monitor

General Process

- Set up Inkjet Printer
- Create Profile
- Read Colorimetric Values and Create Photoshop Wireframe from IoC
- Add Colorimetric Values from IoC to Photoshop Wireframe
- Print to Inkjet Using Profile
- Evaluate Printed Result
- Standardized Viewing
- Read Colorimetric Difference
- Iterate to Optimize

"One Color as Two"

Sample from IoC
Print Out the Illustrations and Adjust Until Reaching Satisfactory Results

"Two Colors as One"

Conclusions: Inkjet Printer Method
- Color-managed Inkjet Printers Can Create Desired Colors and Illustrate Simultaneous Contrast
- Fully Optimized Results May Require Three or More Attempts
Color-Aid Method

Materials (Color-Aid Method)
- Interaction of Color (2009)
- Color-Aid Papers
- Software
  - Excel Spreadsheet
  - X-Rite ColorMaster QA Master V
  - Adobe Photoshop
  - i1 Profiler Display
  - Standardized Viewing Condition
  - i1 Profiler Display
  - NEC PA24 Monitor
  - Spectrophotometer (X-Rite SpectroEye Spectrophotometer)

Using Colorimetry to Select Color-Aid

Color-Aid Samples Read into Database

Colorimetric Wireframe from Photoshop

Select Color-Aid to Illustrate IoC

Method 1: Based on Lowest Delta E
Method 2: Based on Color Relationships from "Anchor" Samples

Photoshop Wireframes
Colorimetric Values in Database
Soft Proof Validation
"One Color as Two"

Select Color-Aid: Lowest $\Delta E_{00}$ Method

- Search for Lowest $\Delta E_{00}$
- Read Colors from IoC
- Search for Closed Color-Aid in ColorMaster Database
- Add Values to Photoshop Wireframe
- Enter Colorimetric Values in Photoshop
- Soft Proof and Analyze Results
- Calibrated, Profile Monitor
- Compare to IoC

Lowest Color-Aid $\Delta E_{00}$ for Each Color in IoC Sample

<table>
<thead>
<tr>
<th>Color</th>
<th>IoC</th>
<th>ColorMaster</th>
<th>Photoshop Wireframe</th>
<th>Evaluated as Soft Proof</th>
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<td>$C^*$</td>
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<td>55.3</td>
<td>55.3</td>
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</table>

Selected Lowest $\Delta E_{00}$ from Color-Aid

Filled into Photoshop Wireframe

Evaluated as Soft Proof – Compare to IoC

Alternative Method: Optimization via Color Relationships

- Can Selection of Color-Aid be Optimized by Examining Color Relationships in IoC?

Reminder: Criteria of Simultaneous Contrast

- Adjacent color shift toward the complement of the other
- Mixed hues are more influenced than pure hue
- Dull colors change more easily than bright
- Light values are easier to change
- Strong contrast will create more extreme change (value)
- Less contrast result in less change

General Procedure: "Anchor" Color/Relationship Method

Select "Anchor" Colors
Examine Relationships between "Anchors" and Other Colors
Search Color-Aid Database for Samples that Best Represent Relationships
Soft Proof and Analyse Results

Select "Anchor" Colors

Relationships from IoC to Select Color-Aid

Verify Results: Soft Proof

"Two Colors as One"
Select Color-Aid: Lowest $\Delta E_{00}$ Method

- Search for Lowest $\Delta E_{00}$
  - Read Colors from IoC
  - Search for Closed Color-Aid in ColorMaster Database

- Add Values to Photoshop Wireframe
  - Enter Colorimetric Values in Photoshop

- Soft Proof and Analyze Results
  - Calibrated, Profile Monitor
  - Compare to IoC

Lowest Color-Aid $\Delta E_{00}$ for Each Color in IoC Sample

- Search for Closed Color-Aid
  - Search in ColorMaster Database
  - Soft Proof and Analyze Results
  - Calibrated, Profile Monitor
  - Compare to IoC

Selected Lowest $\Delta E_{00}$ from Color-Aid

- Filled into Photoshop Wireframe
  - Evaluated as Soft Proof – Compared to IoC

Alternative Method: Optimization via Color Relationships

- Can Selection of Color-Aid be Optimized by Examining Color Relationships in IoC?

General Procedure: "Anchor" Color Relationship Method

- Select "Anchor" Colors
- Examine Relationships of "Anchor" and Adjacent Colors
- Search Color-Aid Database for Samples that Best Reflect Adjacent Colors
- Soft Proof and Analyze Results

Relationships from IoC(*) to Select Color-Aid

- Search Color-Aid Database for Samples that Best Reflect Adjacent Colors
- Soft Proof and Analyze Results
Relationships from *IoC* to Select Color-Aid

<table>
<thead>
<tr>
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<tr>
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<tr>
<td>(b^*)</td>
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</table>

Verify Results: Soft Proof

Compare “Lowest Delta-E” Method to “Anchor Color with Relationships” Methods for Selecting Color-Aid using a Profiled Monitor and *IoC*

In This Case, “Anchor Color with Relationships” Methods Better Represented Simultaneous Contrast as seen in *IoC*

**Conclusions: Color-Aid Method**

- Results were Inconclusive
- Lowest \(\Delta E_{00}\) Method and “Anchor” Color-Relationship Method Yielded Different Results
- Dependent on Sample Selected
- Dependent on visual and colorimetry analyze to prove results

**Conclusions**

- Colorimetric Color-Aid Method Does Not Efficiently Replace Visual Analysis
- Color-managed Inkjet Printers Can Create Desired Colors
- Remember: Albers’ Goals for Color Studies Curricula Include:
  - Simple and quick
  - Practical
  - More choices
- Suggests that Students can Create Colors to Supplement Color-Aid in Efficient Manner using Color-managed Tools and Inkjet Printers

**Future Research**

- Go Through Other Examples in *IoC* to Validate Present Findings
- Psychophysical Studies to Supplement Validation of Results
- No Comparison of the Size and Proximity of the Simultaneous Contrast Colors from the Illustrations
- Classroom Studies to Gage Effectiveness of Different Teaching Approaches
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