



Further Investigation into the Image Quality Differences Between Digital Print Technologies and Offset Lithography

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Project Background

- Several high-end digital “presses” introduced in the past decade
 - How does the image quality of this equipment compare to that of offset lithography
- Results from PIC study conducted in 2007 indicated that people preferred prints made by offset on coated paper but found the digital prints to be comparable or slightly preferable on uncoated paper
 - Uniformity and text and line quality the major image quality issues for digital equipment
 - Contrast (and gloss) the issue for offset

Research Objectives

- Determine the difference between the image quality of digital printers and that of offset lithographic presses
- Determine what particular image quality parameters are particularly relevant in comparing print systems technologies
- Determine the impact of the unintended color shifts in last year's experimentation
- Determine the difference between the image quality level required by print buyers relative to that required by end users
- Determine the impact of the media

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Image Quality Parameters

- **Printing digital photographs**
 - Color reproduction, uniformity, resolution, artifacts
- **International Standards**
 - Gloss, color rendition, uniformity, text and line quality, and sharpness and effective resolution
- **Print Industry Center (Chung and Rees)**
 - Color rendition, resolution, text quality, and artifacts

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Project Methodology

- Establishing a set of images for evaluating image quality
- Acquisition of prints of the established image set a variety of machines printed on a variety of media
- Psychophysical experimentation using the acquired prints

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Image Set

- Include images covering the categories suggested by Frey for work on image permanence
 - Direct mail
 - Marketing and promotional materials
 - Business communications
 - Photo books

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Printing Equipment Used

- All presses located on the RIT campus, all except the iGen3, in the Printing Applications Laboratory
 - HP Indigo 5000 (Experiment 1),
 - HP Indigo 5500 (Experiment 2)
 - NexPress 2100
 - iGen3
 - Heidelberg Speedmaster sheetfed press
 - Prinergy Workflow 3.0.2.2
 - Kodak Thermal Gold plates on a VLF 5080 Quantum platesetter
- Coated and uncoated paper

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Psychophysical Experimentation

- Magnitude Estimation methodology
- D50 lighting
- Range of participants from RIT campus environment

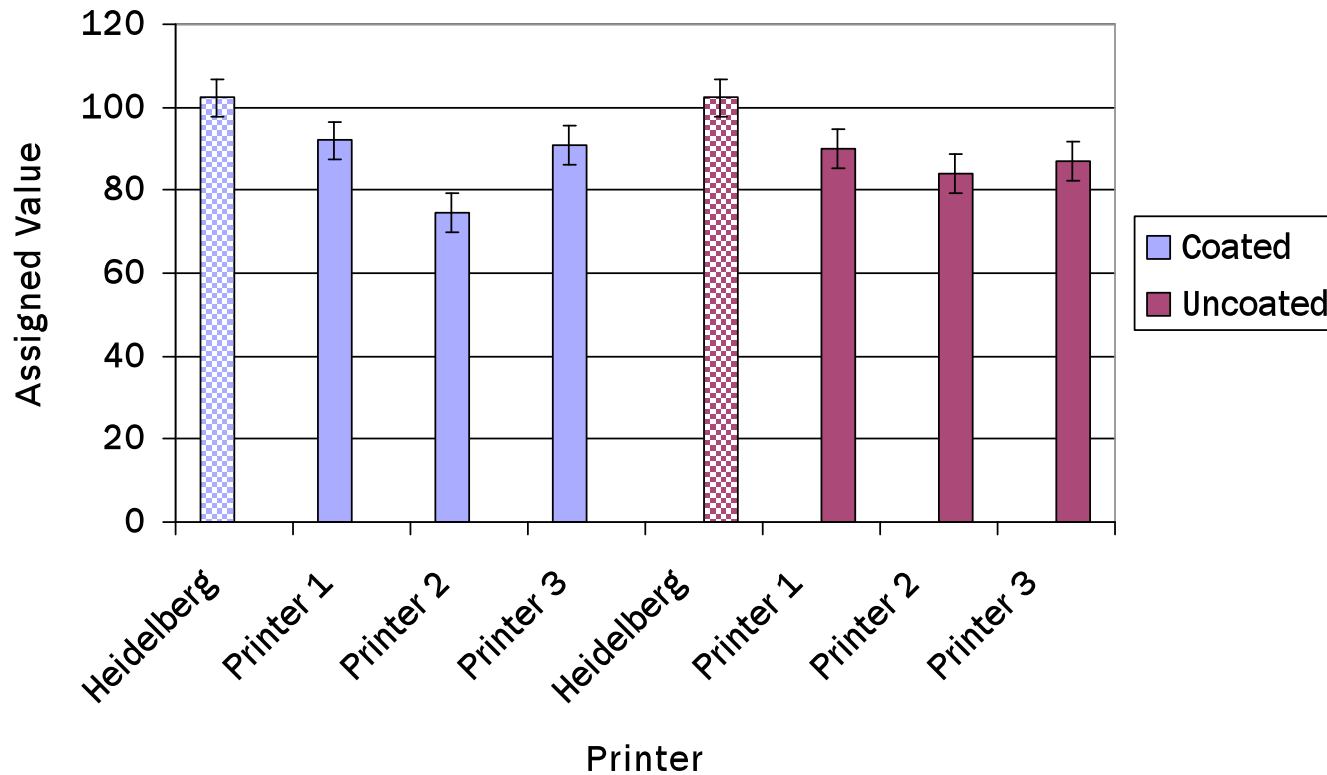
Psychophysical Experimentation

- Magnitude Estimation methodology
- Anchored scaling
 - Print from Heidelberg Speedmaster designated as the reference print
 - Arbitrarily assigned a value of \$1.00
- Comparison prints rated relative to the reference
 - If quality enough better to justify paying more, specify how much more
 - If quality enough worse to justify paying less, specify how much less
 - If quality essentially comparable, even if the prints looked quite different, then same \$1.00 as the reference

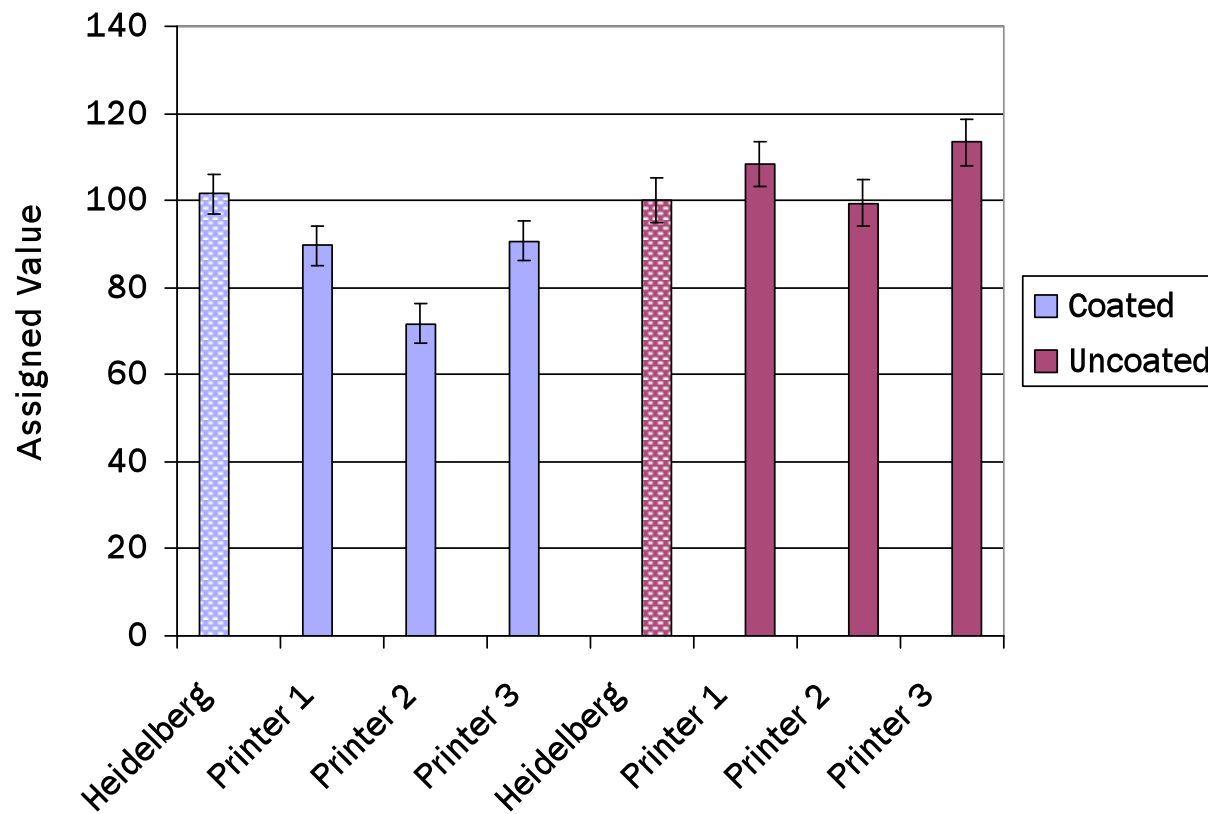
Project Methodology: Experiment I

- Image set the same as for 2007 experimentation
- Coated and uncoated cover stock used in 2007
 - Coated: Titan Plus Dull *digital* 100lb. Cover
 - Uncoated: HP Indigo printing paper 80 lb premium cover
- D50 lighting
 - Viewing booth at the Imagine RIT festival
 - Viewing booth in the Psychophysics lab in the Color Science Building
- 21 participants
 - 14 male, 8 female
 - Age range approximately 15-64, majority in 20's

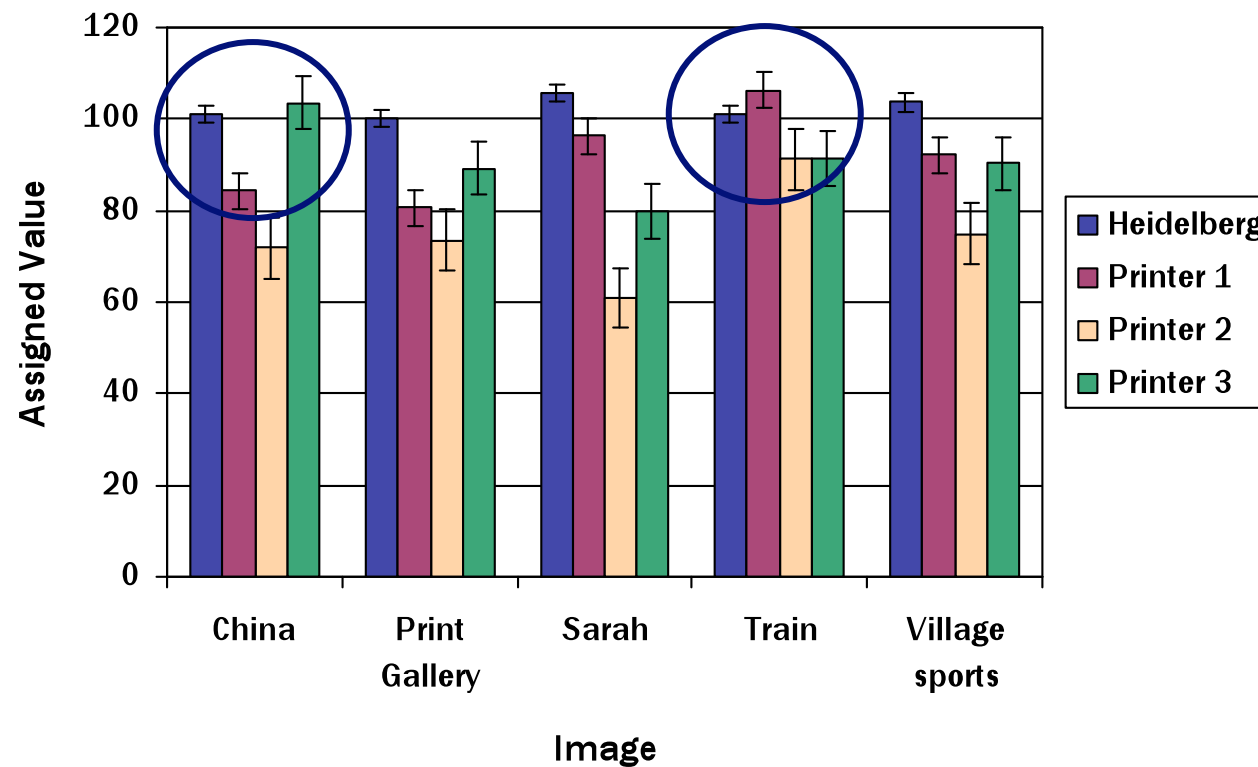
Experimental Results - 2008



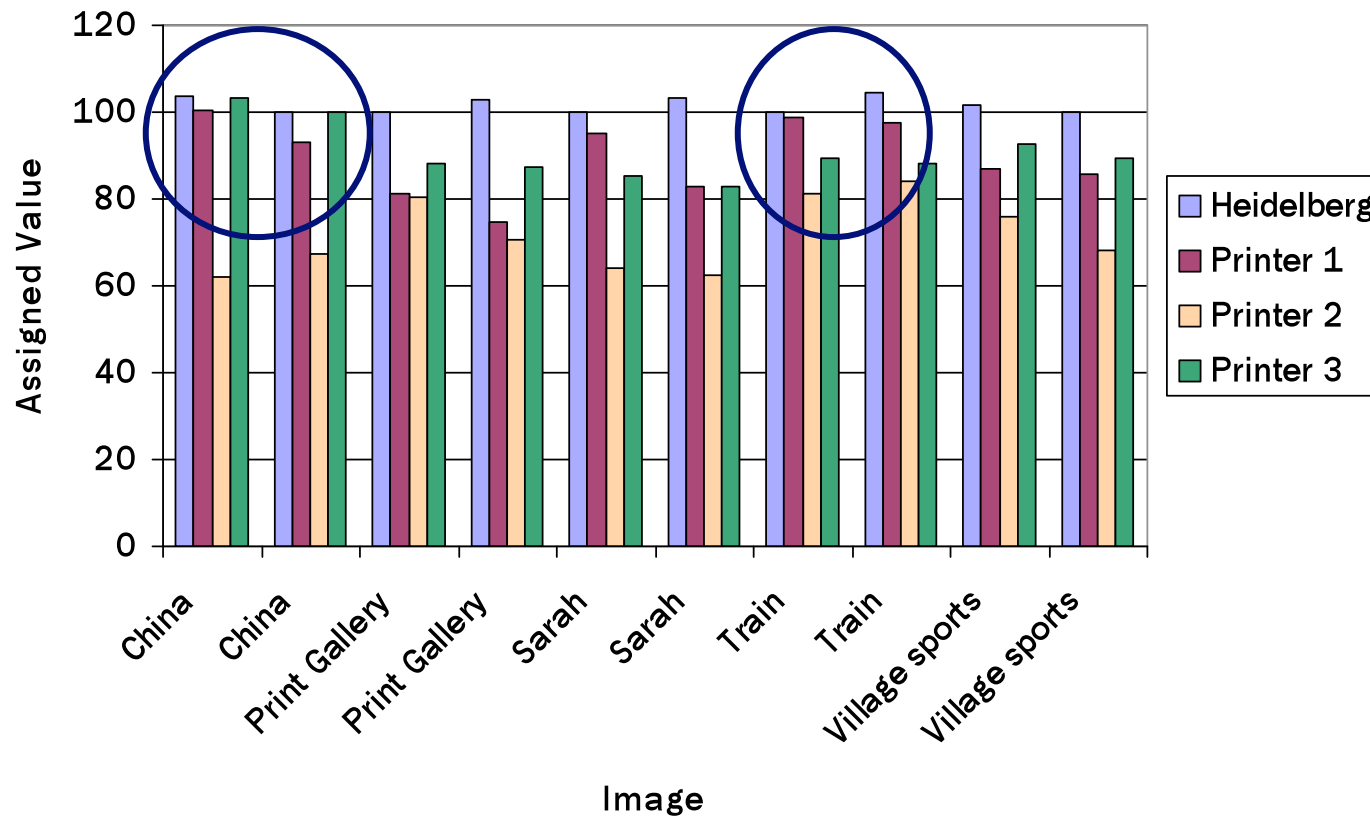
Experimental Results - 2007



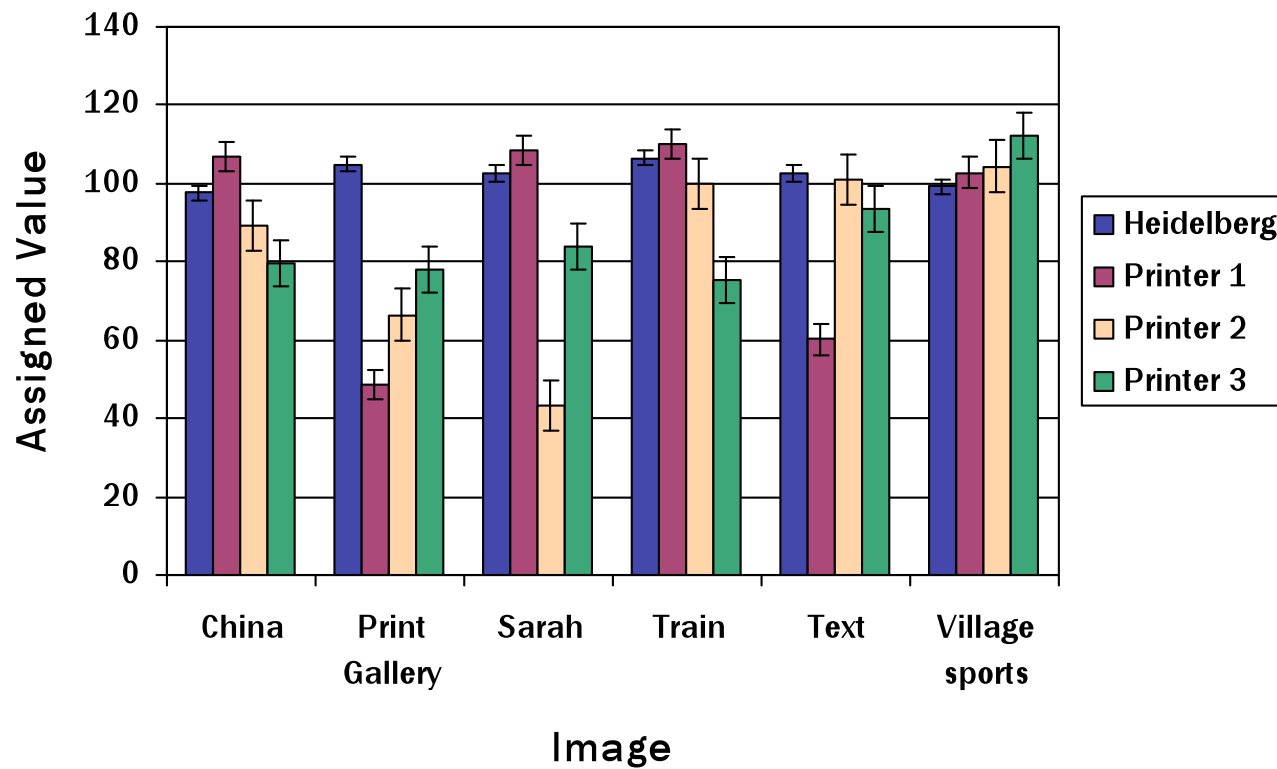
Experimental Results – Coated Paper – 2008



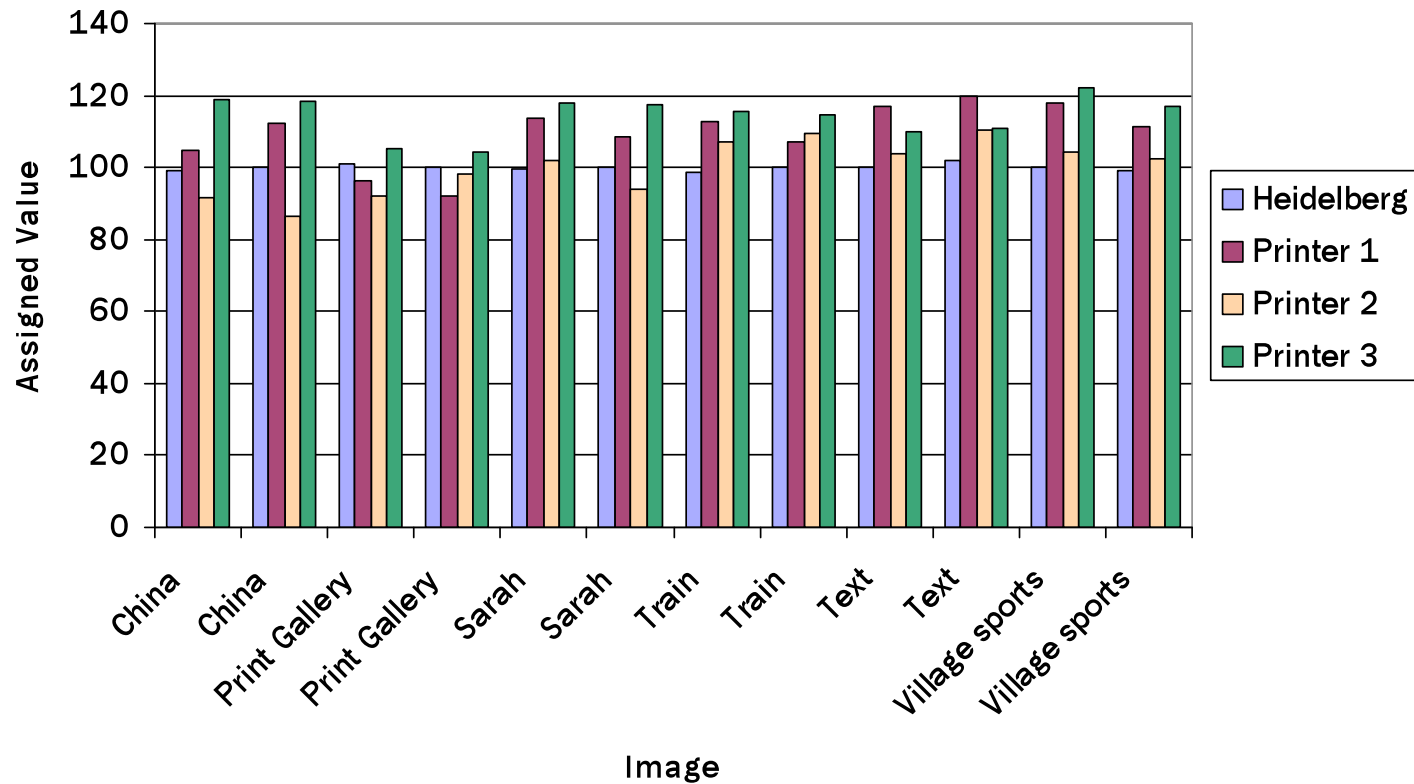
Experimental Results – Coated Paper – 2007



Uncoated Paper – 2008



Uncoated Paper – 2007



What happened?

- **Contrast, contrast, contrast**
 - Digital images printed to look like offset

Observed Trends – Experiment I

- Results on coated media remarkably similar to to the results obtained in 2007 study
 - Participants tended to prefer the prints made with the offset press
 - Unintended color shifts had little impact on experimental results obtained in 2007
- Participants tended to prefer prints made on the offset press on uncoated media
- Image quality attributes cited as important in making judgments generally the same as in the 2007 experimentation
 - Uniformity and lower text and line quality tended to be the image quality problems cited for the digital equipment
 - Low contrast tended to be an image quality issue for the uncoated paper

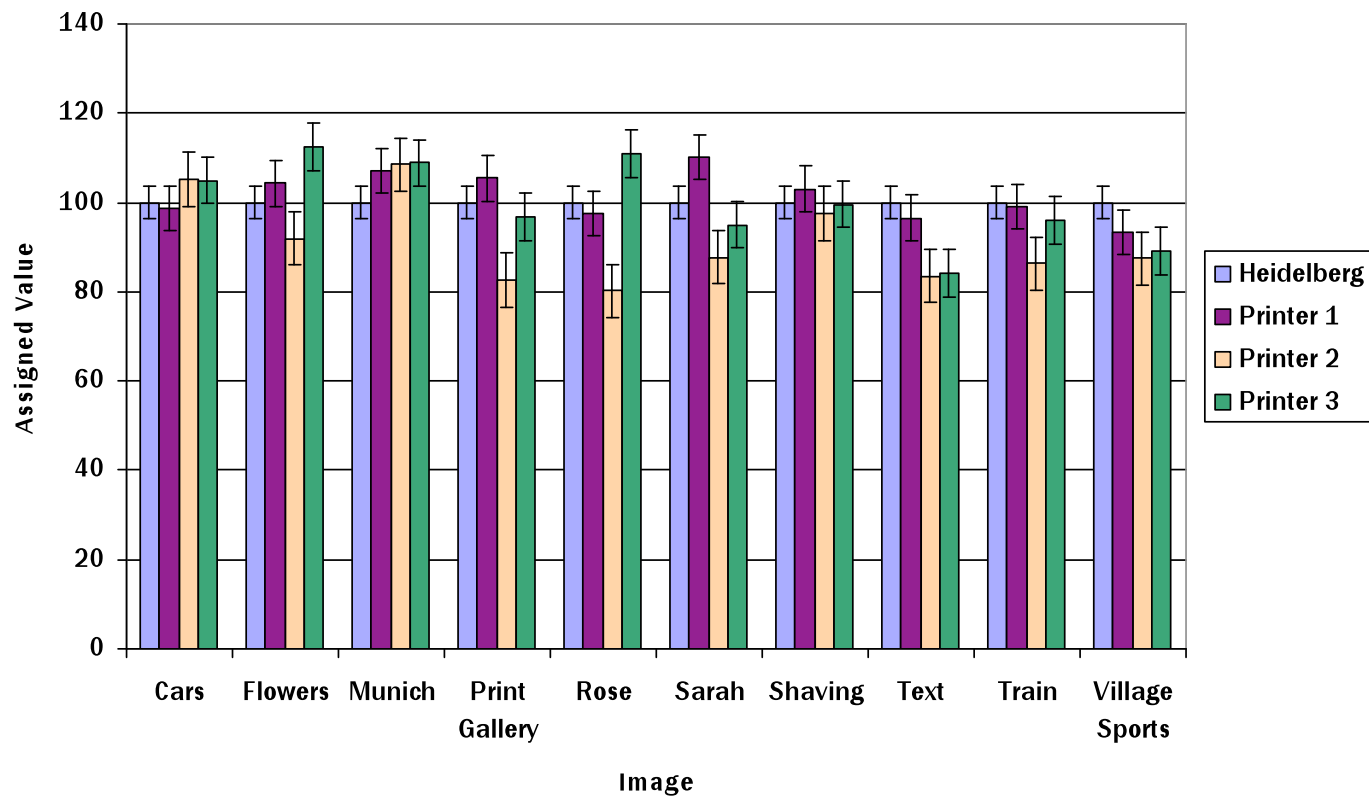
Project Methodology – Experiment II

- Image Set included five images from previous experimentation
 - Print Gallery, Sarah, Text, Train, and Village Sports
- Five new images
 - China replaced by Munich and Cars in photo book category
 - Shaving added in marketing category
 - Flowers and Rose included as “Photos for Display”

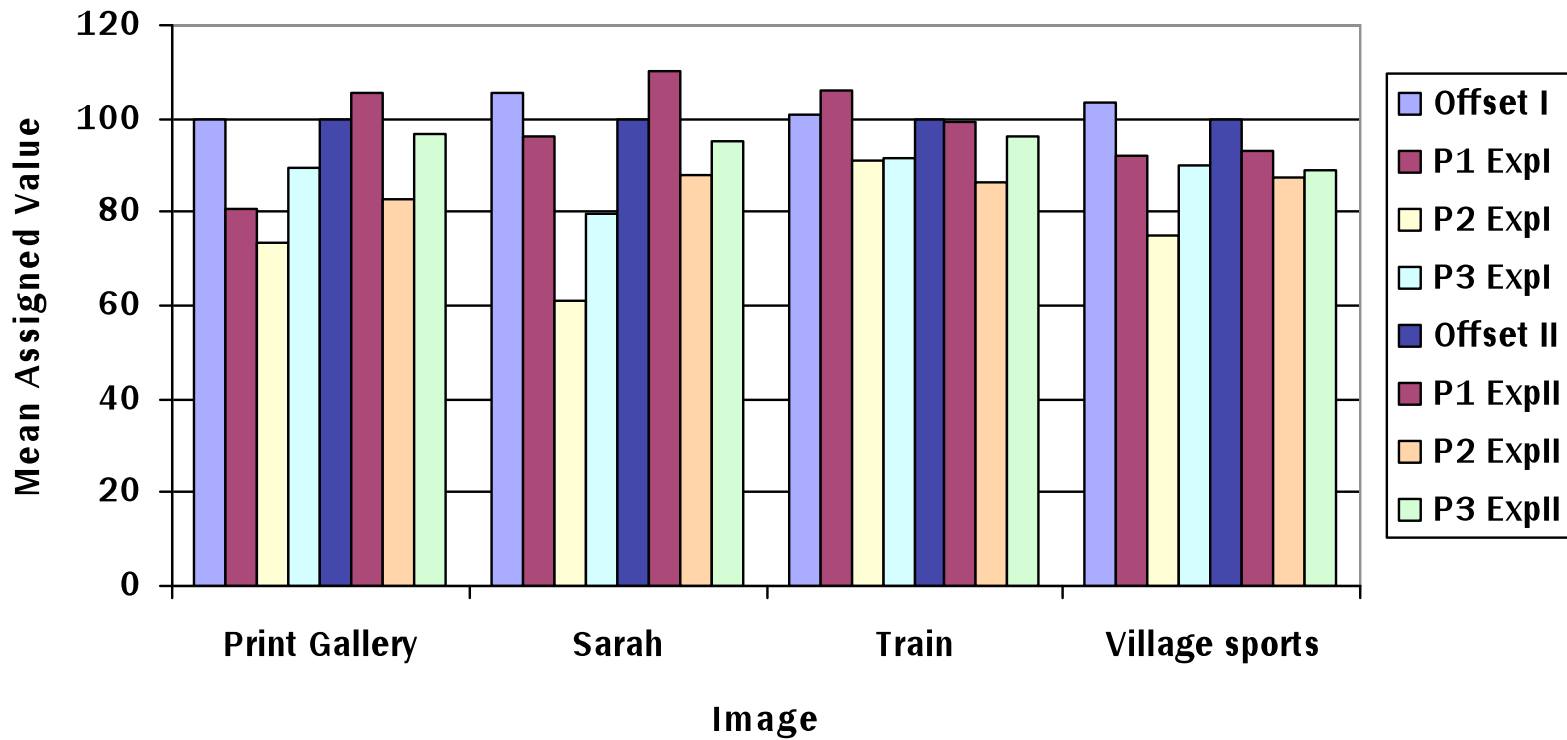
Project Methodology – Experiment II

- Coated and uncoated paper
 - Coated: Titan 80# gloss text
 - Uncoated: Titan 80# Accent Opaque
 - Uncoated: Titan 60# Accent Opaque
- D50 lighting
 - Viewing booth in the Psychophysics lab in the Color Science Building
- 27 participants
 - 12 male, 15 female
 - Age range approximately 18-50, majority in 20's
 - 14 recruited from undergraduate psychology course (wide range of majors), remainder from Color Science and Printing departments
 - 1 reported a color vision anomaly

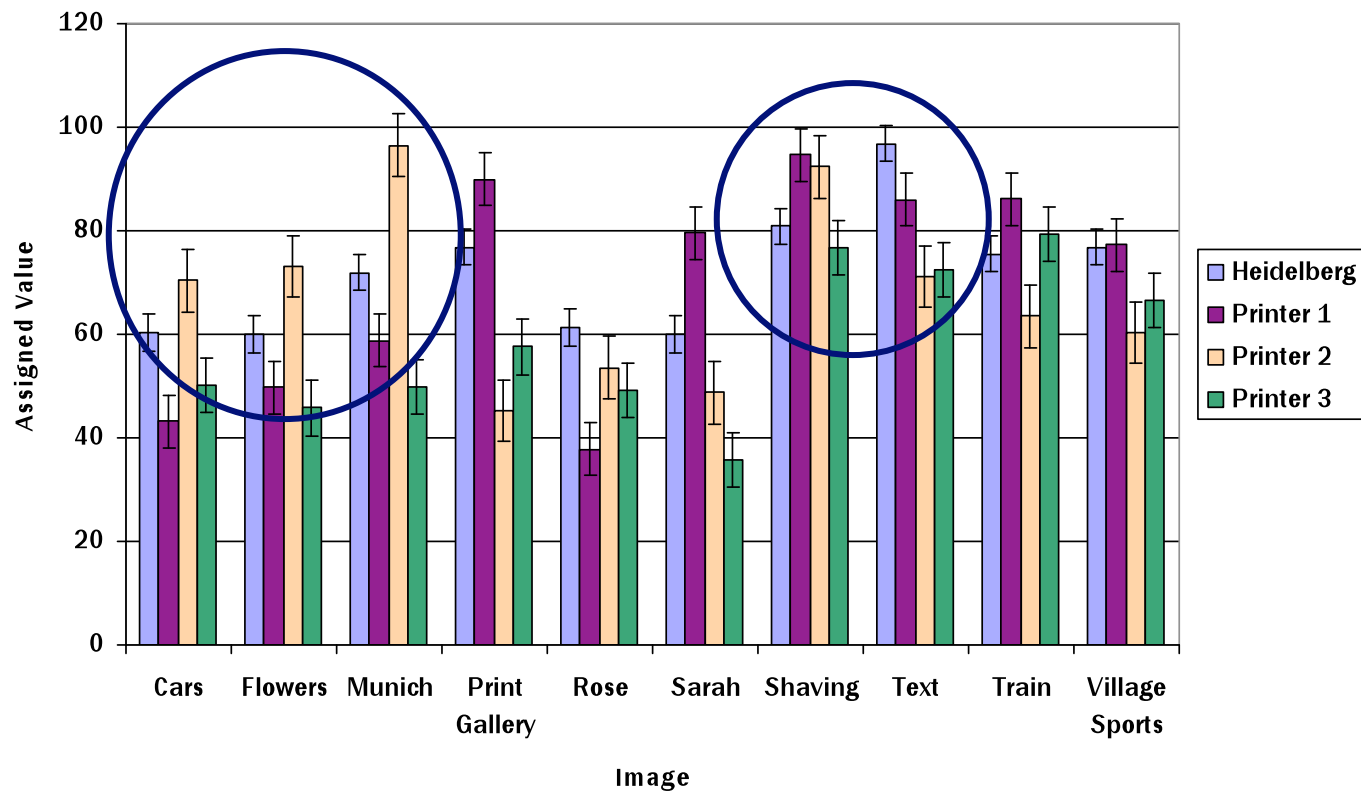
Experiment II – Coated Paper



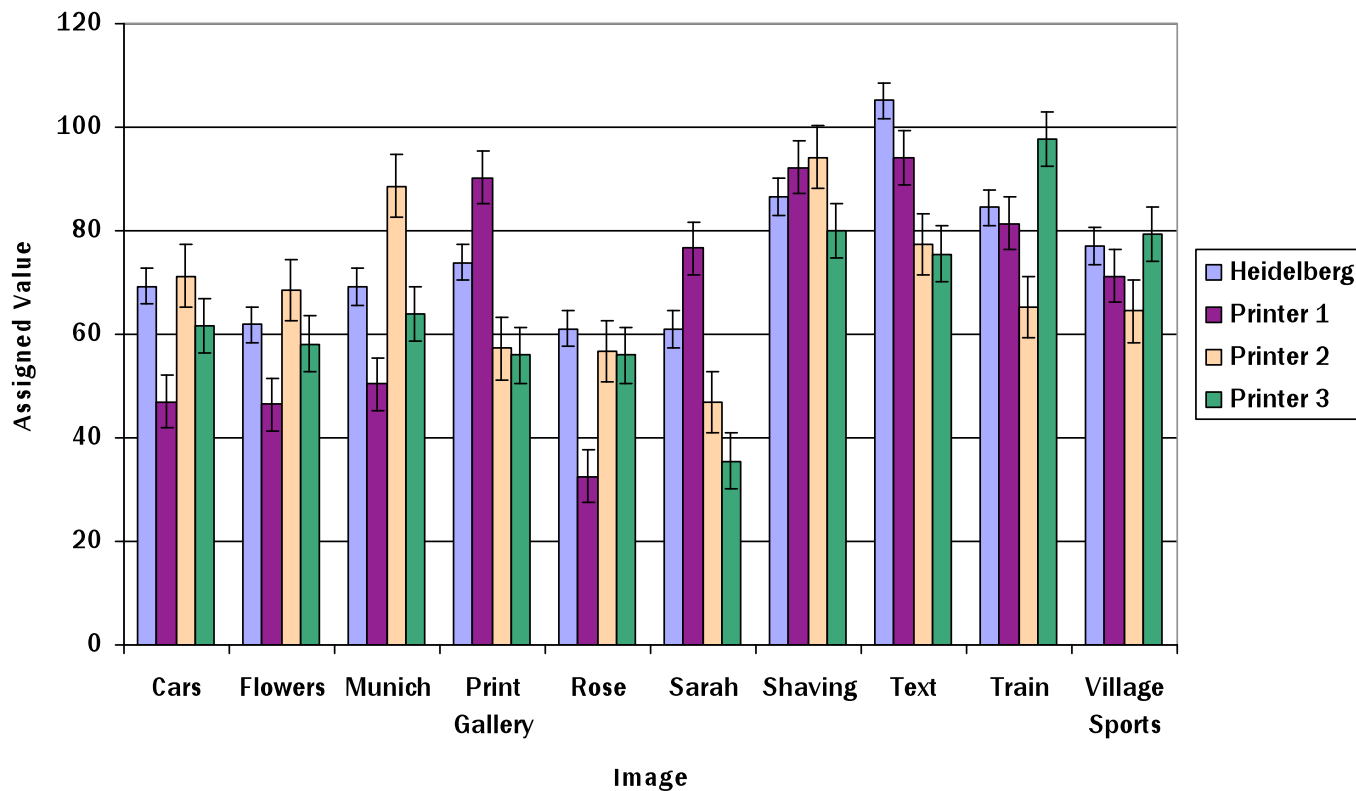
Experiment II – Coated Paper



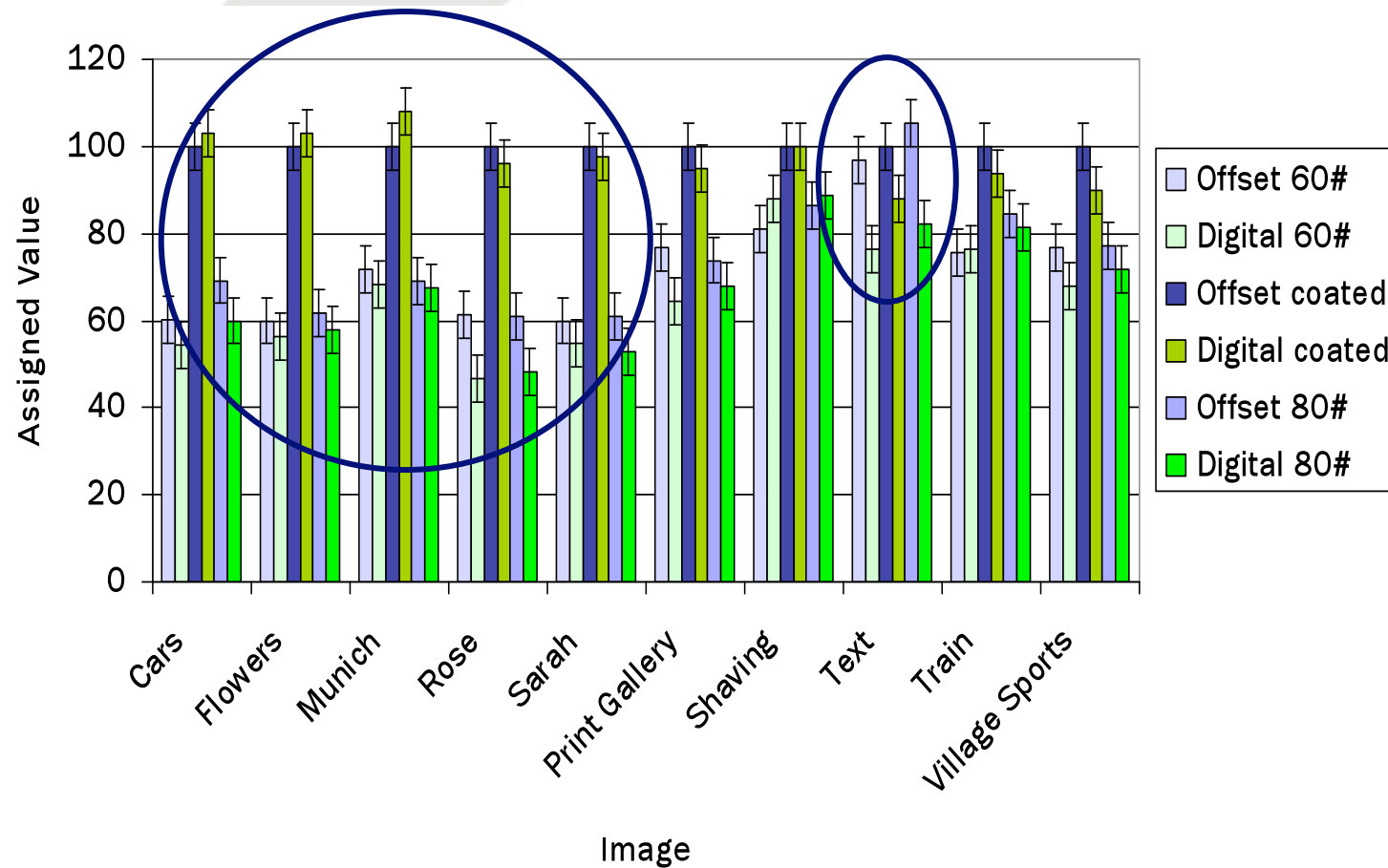
Experiment II – 60# Uncoated Paper



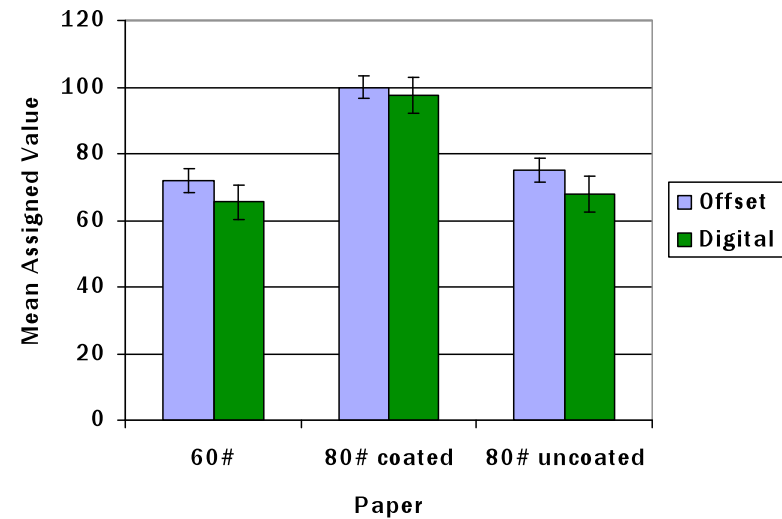
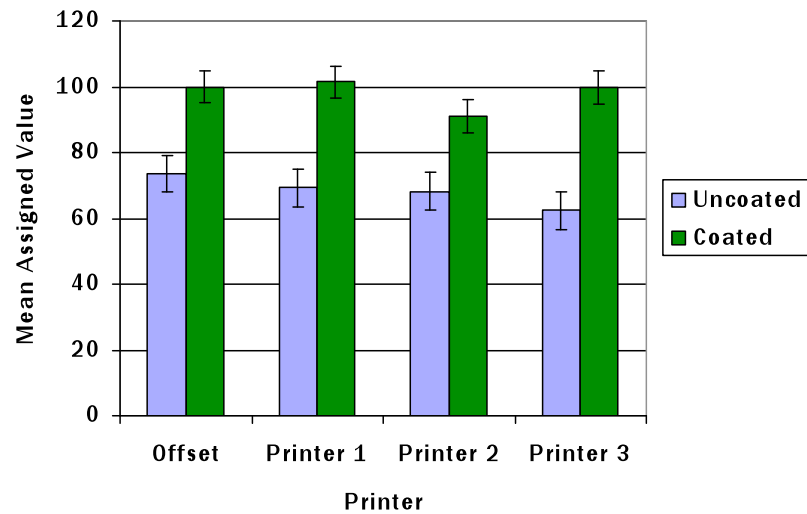
Experiment II – 80# Uncoated Paper



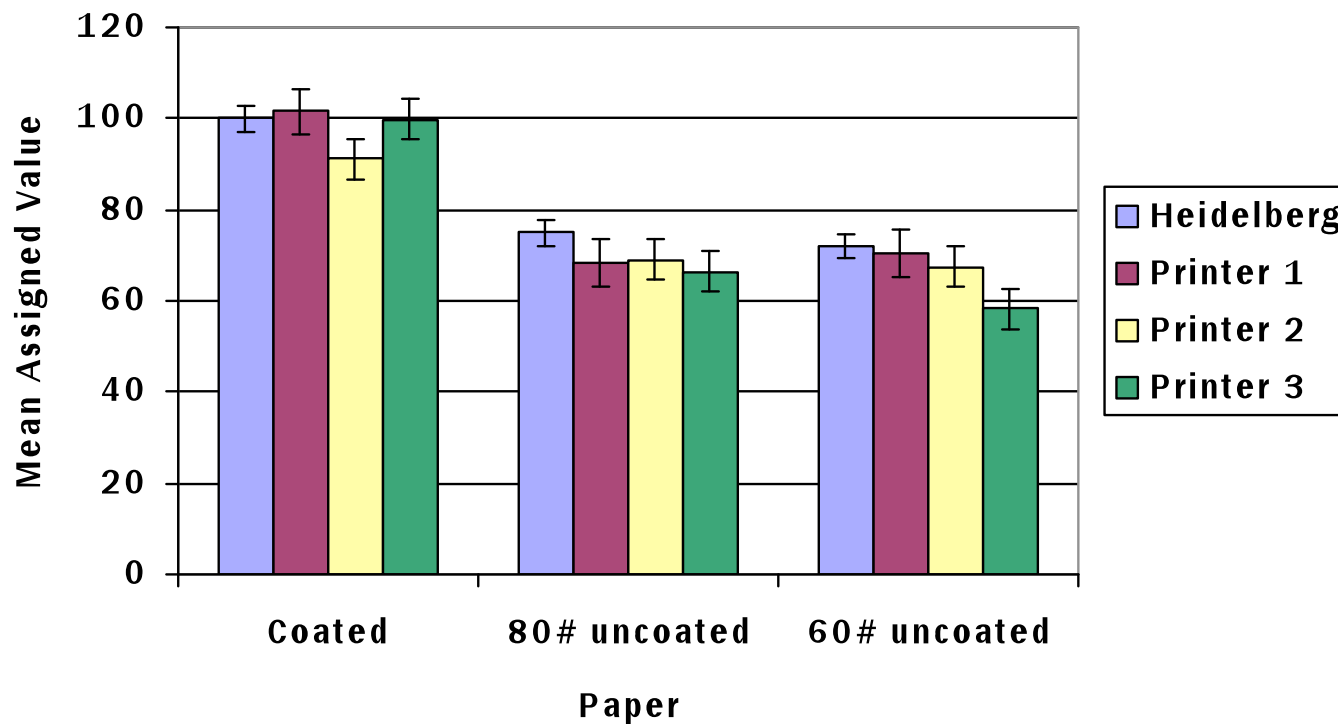
Experimental Results '08



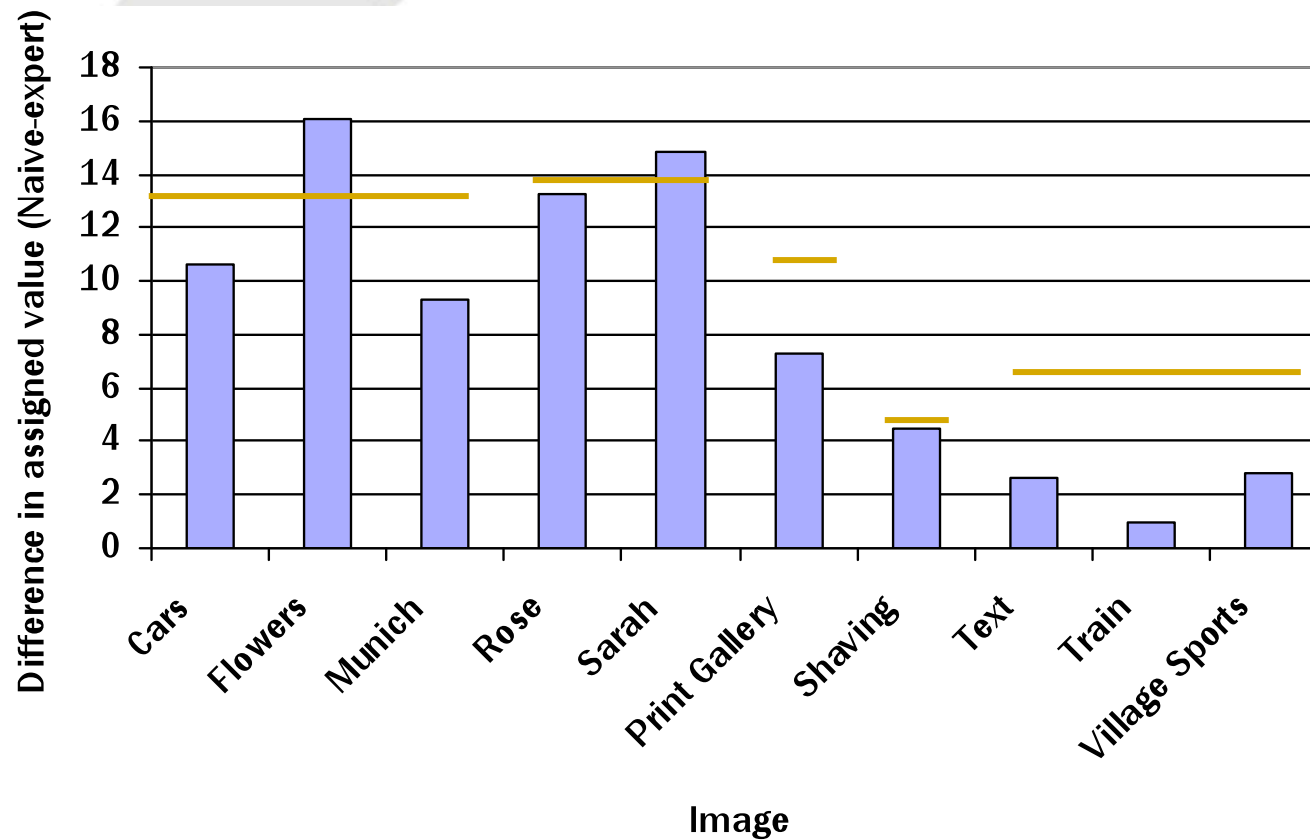
Experimental Results '08



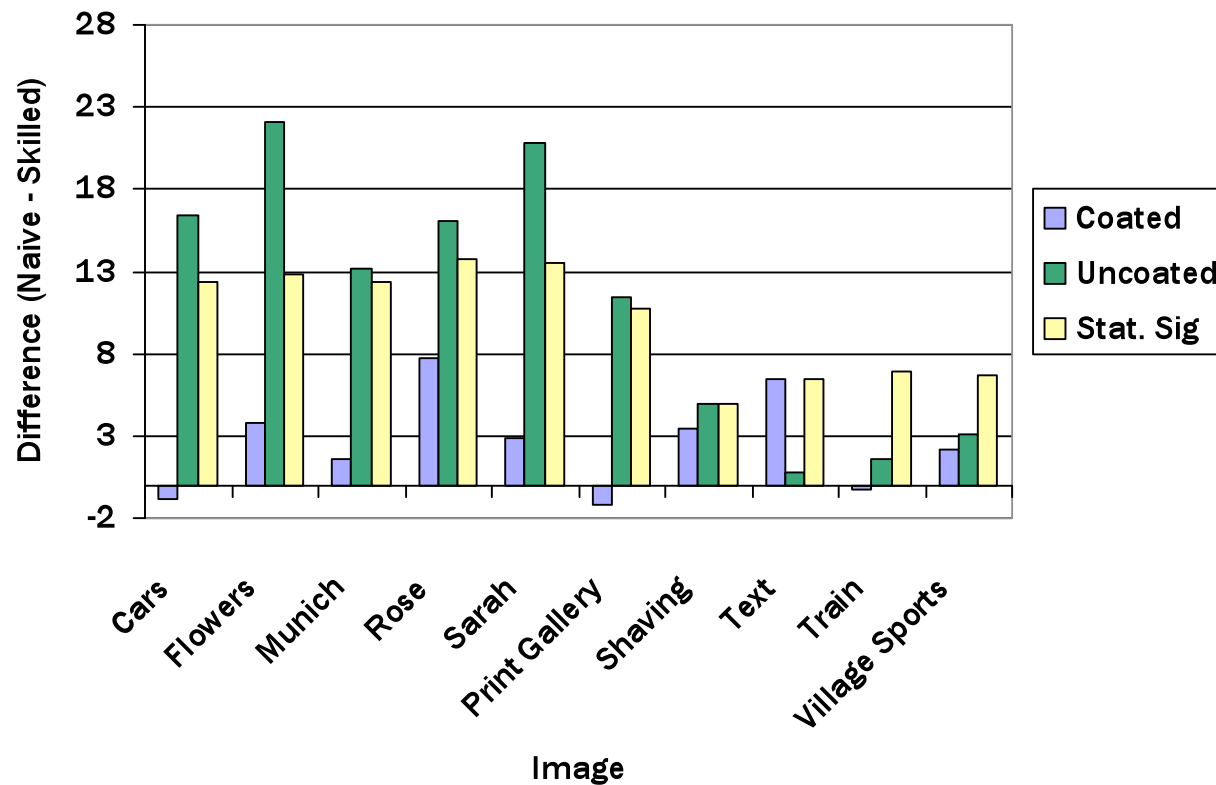
Experimental Results '08



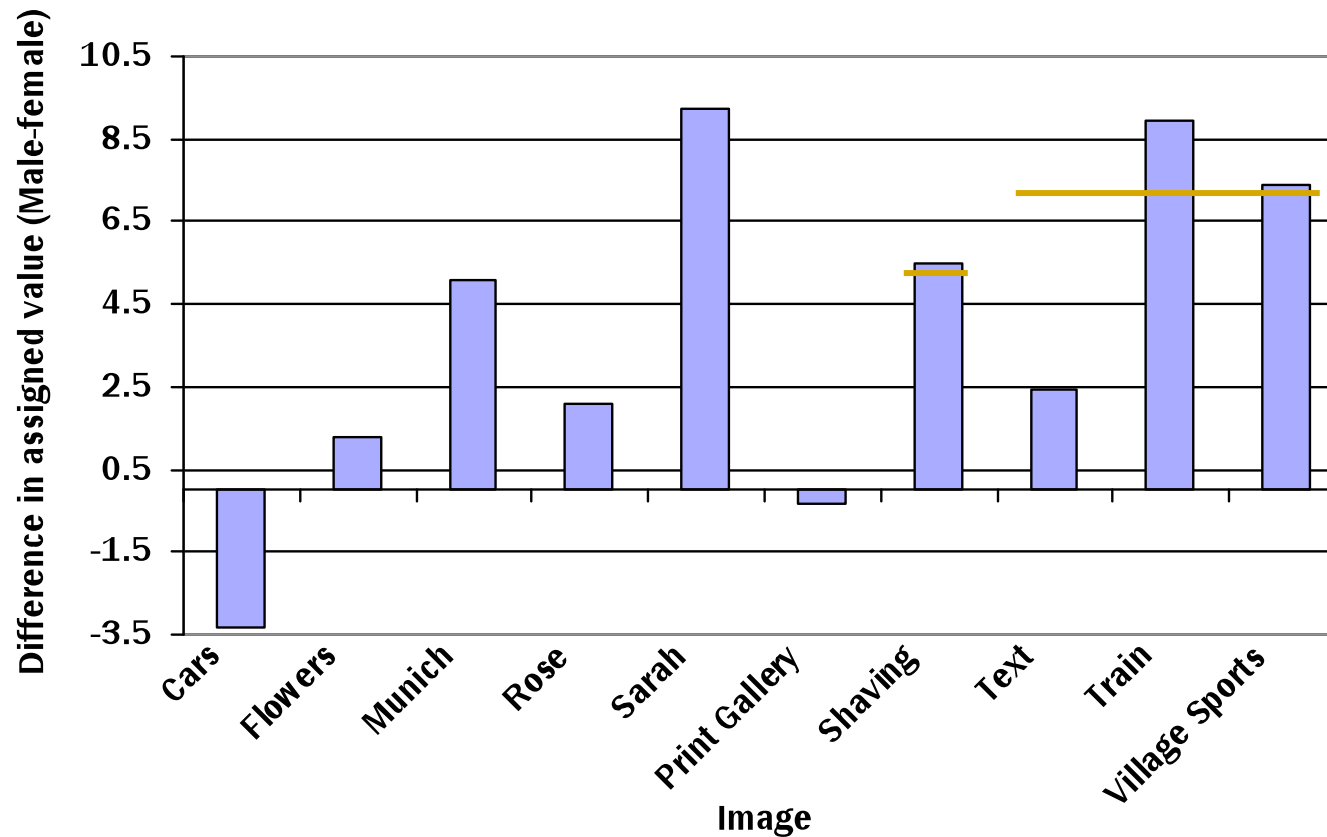
Effect of Participant Image Evaluation Skill



Effect of Participant Image Evaluation Skill



Effect of Participant Gender



Observed Trends – Experiment II

- Participants preferred the prints made on coated media over uncoated media
 - This difference considerably more significant than any difference between print technology
- None of the printing devices produced prints that were consistently more highly rated
 - No significant differences between offset and digital on coated paper
 - Photo prints from Printer 2 without people rated higher than prints from other equipment on uncoated paper
 - Photo prints with people from Printer 1 rated higher
 - Printer 3 performed well for photo prints on coated paper and for the Train print
 - Offset best for text and had fewer issues over all

Observed Trends – Experiment II

- Low contrast (and gloss) tended to be the image quality issue for the uncoated paper
 - Lower text and line quality cited for digital equipment
- Skilled and female observers tended to be more critical than unskilled or male observers
 - Effects were image and media dependent

Observed Trends – 2007

- Participants tended to prefer the prints made with the offset press on coated media
- Participants tended to prefer prints made on the digital equipment on uncoated media
- Uniformity (streaks and grain) and lower text and line quality tended to be the image quality problems cited for the digital equipment
- Low contrast (and gloss) tended to be the image quality issues for the offset press

Observed Trends – Overall

- Media choice may be more important than print technology choice
- Image contrast is a key image quality attribute

Thanks for your attention

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