

Subjective Image Quality Evaluation Part 2

CTIA 2009

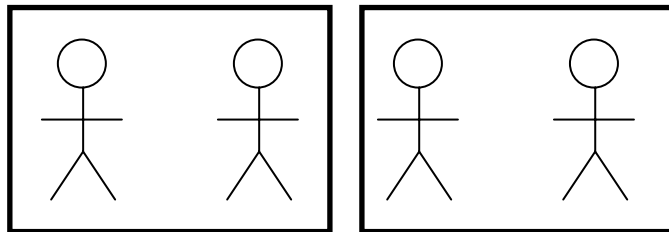
Las Vegas

**Jonathan Phillips
Eastman Kodak Company**

Just Noticeable Difference (JND)

- A JND is a matter of statistics
 - The smallest statistically measurable difference of perception, *e.g.*, smallest perceivable distance between 2 lines
 - Typically, defined when half of the people perceive a difference and the other half are guessing (50% JND)

50% perceive
a change



50% guessing

Specific JND Example

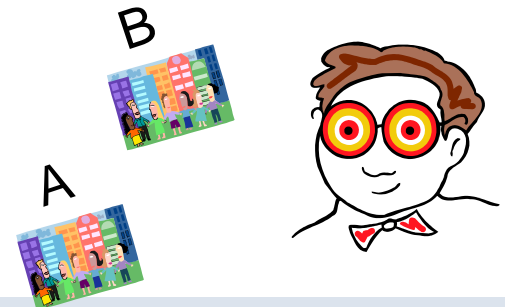
- A JND value is dependent on stimulus
 - Value of 1 JND for change in weight perception of a feather \neq Value of 1 JND for change in weight perception of a filled water cooler jug



Subjective Testing Applied to Photographs

- People are able to judge differences in quality of photographs
- Subjective testing can be quantified into meaningful and repeatable numbers
- When subjective numbers are in JNDs, then results from multiple photographic attributes can be compared and combined

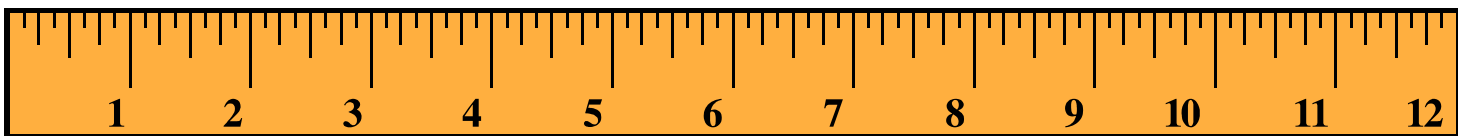
“Which is better—A or B?”



ISO 20462 Method

“Photography—Psychophysical experimental methods to estimate image quality—Part 3: Quality ruler method”

- Standardization of anchored pair method based on JND units
- Substitute length units with an image set having a series of sharpness levels
- Quality ruler approach allows for repeatable and definable results
- Compare test image to images on ruler and pick best match on ruler



Softcopy Quality Ruler

- Softcopy quality ruler method based on ISO 20462 Part 3
 - 30" Apple Cinema Display monitor
 - 34" controlled viewing distance
 - Simultaneous viewing of ruler and test images
 - Quality ruler reference stimuli span 30 just noticeable difference (JND) values in sharpness



16 Ruler Images

- 30 JND levels of sharpness for each ruler image



Softcopy Quality Ruler Screen



Ruler image

Test image 27 of 80

Two side-by-side images of a restaurant interior. The left image is labeled 'Ruler image' and the right image is labeled 'Test image 27 of 80'. Both images show a dining table with a dark tablecloth, set with glassware and plates, surrounded by wooden chairs. The background features a curved booth with a lamp and a framed picture on the wall. The images are used for quality comparison in a softcopy quality ruler screen.

Back

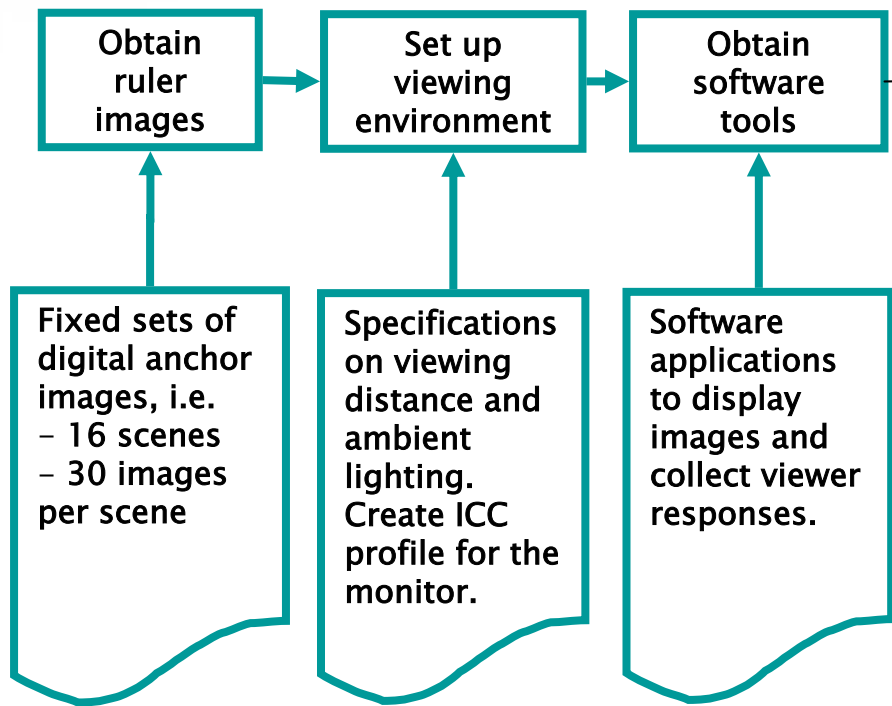
Beyond High Range

Beyond Low Range

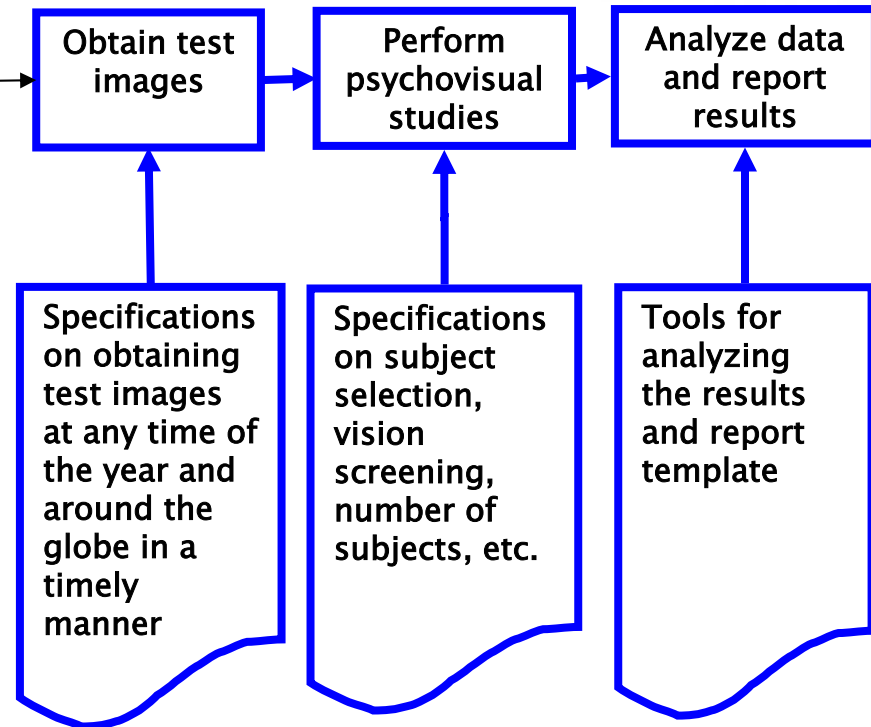
Next

Softcopy Quality Ruler Method Workflow

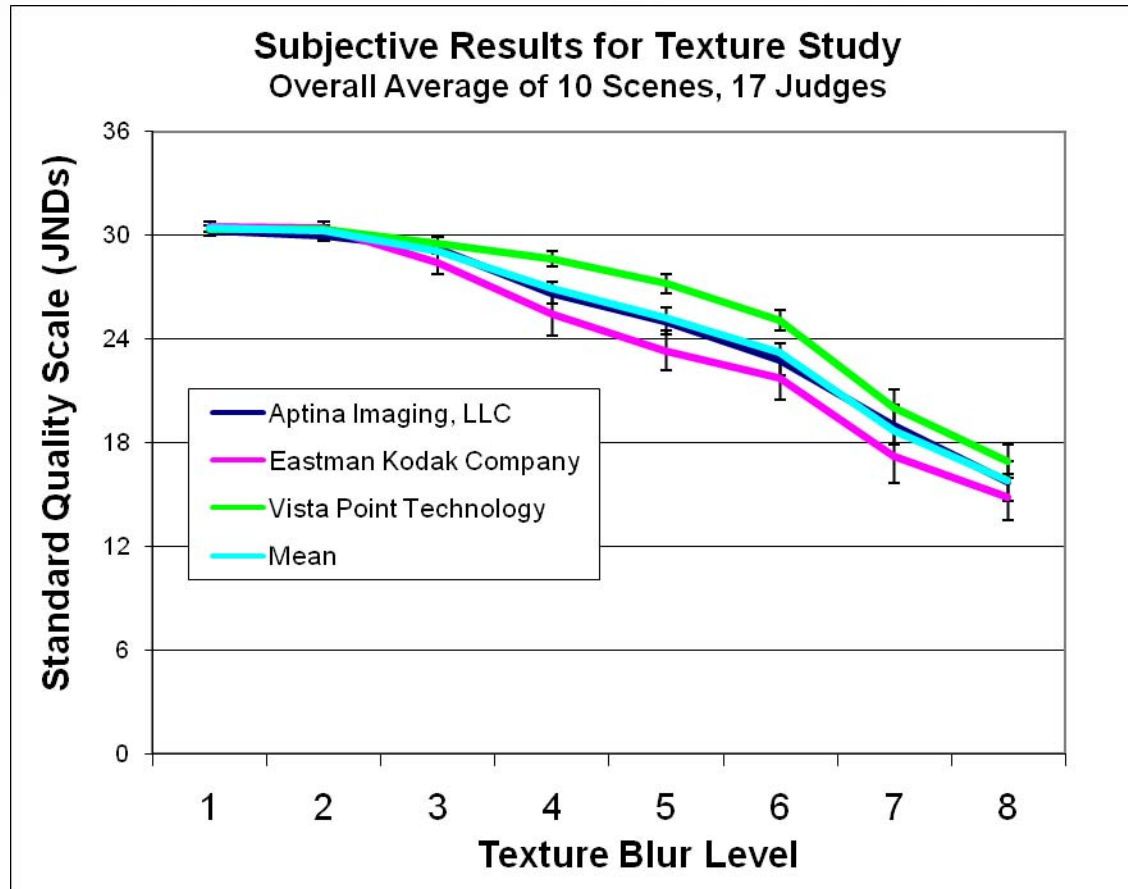
One time setup



Running the tests



Example Ruler Results



Completed Results

- Four CPIQ companies have been running subjective evaluations to obtain JNDs of quality
- Subjective results have been calculated for 4 key image quality attributes
 - Color non-uniformity
 - Lens chromatic aberration
 - Lens geometric distortion
 - Texture blur
- Subjective results have been correlated to objective metrics, allowing for an objective metric to be converted into JND units

Toward a Consumer Rating Scale

- Multivariate analysis allows for combination of JNDs of individual attributes into a predicted overall quality change

$$\Delta Q_m = - \left(\sum_i (-\Delta Q_i)^{n_m} \right)^{1/n_m}$$

where ΔQ_m is the overall JND quality change, ΔQ_i is the JND quality loss due to a particular i^{th} attribute, and n_m is an assigned weighting value

- ΔQ_m can be associated with a specific consumer rating
- The weighting value, n_m , can be made variable in order to account for different weightings for different attributes

Phase 3 Development

- Recommendations for making the subjective testing more robust to experimental variability
- Recommendations for minimum number of observers to obtain reliable subjective results and how number of observers influences test variability and reliability
- Methods for removing observers from the data pool who exhibit poor usage of the quality ruler
- Investigation of potential alternative subjective test methods
- Involvement from additional companies in the development of subjective testing