

CIE TC8-04 Meeting (June 15, 1999) Minute

Prepared by Michael Stokes and modified by Naoya Katoh

1. Meeting of CIE TC8-04 "Adaptation under mixed illumination conditions"

Chair: Mr. Naoya Katoh (Japan)

June 25, 1999, 15:30-17:50 Warsaw at 24th Session of the CIE

Opening meeting, Naoya Katoh, CIE TC8-04 chair distributed copies of TC8-04 web site documents including experimental guidelines and copy of his J.EI paper describing some of his previous experimental work.

CIE8-04 Home Page; <http://www.colour.org/tc8-04/>

Experimental Guideline; http://www.colour.org/tc8-04/Experiment_guideline.html

N. Katoh, et al., "Effect of ambient light on color appearance of softcopy images: mixed chromatic adaptation for self-luminous displays," J. Elec. Imaging 7, 794-806 (1998)

2. Introductions

- Naoya Katoh, (Japan) [naoya@color.sony.co.jp], TC8-04 chair
- Dong-Ho Kim, (Korea) [donghokim@thrunet.com]
- Paula Alessi, (USA) [pjalessi@kodak.com]
- Todd Newman, (USA) [todd_newman@cisnc.canon.com]
- Janos Schanda, (Hungary) [schanda@ella.hu]
- Klara Wenzel, (Hungary) [wenzel@coloryte.hu]
- Itala Kucsera, (Hungary) [kitala@coloryte.hu]
- Hirohisa Yaguchi, (Japan) [yaguchi@image.tp.chipa-u.ac.jp]
- Michael Stokes, (USA) [michael_stokes@hp.com] (representing members Oskoui and Pirrotta)
- Monica Billger, (Sweden) [billger@arch.chalmerrrs.se]
- David McDowell, (USA) [mcdowell@kodak.com]

3. Apologies received

- Elie Khoury (France)
- Peyma Oskoui (USA)
- Elizabeth Pirrotta (USA)

4. Discussion

4.1. Email to TC members from members Pirrotta and Oskoui

Mr. Newman commented on Ms. Pirrotta and Ms. Oskoui's and noted that it was important to know mixed illumination for both single and cross-media. Mr. Katoh agreed that Ms. Pirrotta's and Ms. Oskoui's methods and experiments could be considered as a subset within CIE TC8-04 terms of reference and welcomed the inclusion of their work within the committee.

Ms. Alessi commented that the TC might be more effective if it focused on a single experiment at a time and build "pieces of an experiment." She described similar experiences in TC1-27. Mr. Schanda commented on his experience in colour adaptation experiments and the difficulty involved in this work. He asked if the TC was interested in the white point first and how the white point was changing if we had mixed illumination. Mr. Katoh acknowledged that scientifically it is more correct to work step by step, but industry needs some answers more quickly. Ms. Alessi pointed out that such an approach might lead to unsound conclusions.

Mr. Newman commented that many of these issues were psychological, such as memory matching. Mr. Schanda pointed out that one always does memory matching. Ms. Alessi asked if it would take a long time to estimate simply the white point. Mr. Newman commented that Ms. Oskoui and Ms. Pirrotta have been working on this issue for the last year. Mr. Stokes volunteered to ask Ms. Oskoui and Ms. Pirrotta to share the results of their research with the TC as soon as possible.

4.2. Which colour appearance model to use

Ms. Alessi asked if CIECAM was the only model the TC would target. Mr. Newman asked if there was any reason to test other models. Ms. Alessi stated that Mr. Fairchild considered ZLAB more appropriate for industry. Mr. Katoh commented that such metameric matches are of an order of a delta E less than 1.0, but with the common industry situations of fluorescent illumination and displays with white points of 9300 have matches where the delta E is an order of magnitude larger. He pointed out that potentially other chromatic adaptation matrices could be used in addition to those in CIECAM. If any improvements were found, this information could be fed back to TC8-01. Ms. Alessi commented that Mr. Luo will report on CIECAM progress later in the divisional meetings.

Mr. Katoh asked everyone to look on page six of his handout (copy of TC web page) where the experimental guidelines points out the difference in luminance range between

softcopy and hardcopy is fairly close. Ms. Alessi commented that Ms. Braun's work for TC1-27 also agreed that little difference was found when the range of luminances in the experimental guidelines were used. Mr. Stokes noted that internal Hewlett-Packard Company research also confirmed this.

4.3. Whether basic colorimetry works for softcopy/hardcopy?

Ms. Schanda stated that we have to be sure that the metameric match between hardcopy and softcopy actually does match. Ms. Alessi stated that they have successfully done so at the Williamsburg Conference. Mr. Newman shared that Canon has also successfully performed such matches at D50 and D65 within the laboratories in Japan.

4.4. Luminance levels and limiting models to chromatic adaptation

Mr. Newman asked if we were only dealing with chromatic adaptation differences and if we were not going to deal with luminance differences. Mr. Katoh indicated that many softcopy situations, the softcopy and hardcopy are similar luminances. Mr. McDowell indicated that current ISO recommendations did not cover hardcopy/softcopy situations, but there is work on this in early stages ISO TC 130. Mr. Newman suggested we test with a full color appearance model rather than just testing a chromatic adaptation model.

4.5. Which light source to use

Mr. McDowell asked Ms. Alessi for details for her work. Ms. Alessi stated they used D50 simulators. Mr. McDowell commented that it is very important to use the actual spectral power distribution of the illumination source since many simulators vary tremendously from each other.

4.6. Recommended use and preparation of pictorial images

Mr. Katoh reviewed the experimental guidelines and recommended the use of pictorial images. Mr. Newman suggested we use the same set of images. Ms. Alessi volunteered to help provide such imagery with photographic prints.

Mr. Newman pointed out that these images might have gamut mapping included and this was dependent upon colour spaces. Mr. Katoh suggested that we should eliminate the issue of gamut mapping as much as possible. Ms. Alessi commented that based on the diagram from the EI October 1998 Vol. 7(4)/799 article that their images

were optimized to avoid gamut mapping, but it was very dependent upon the colour appearance model.

Ms. Kucsera commented that we might consider looking at single patches to determine whether we can match before we look at images. Mr. Katoh commented that this was a very interesting approach but expressed concern that this might introduce different results from complex images. Ms. Alessi stated that one of the TC1-27 does have a test chart within one of the complex images.

Mr. Katoh agreed that the images are very important and that we should be able to make the pixels almost in gamut. Ms. Alessi agreed that for single systems, this was possible. Mr. Newman suggested we at least have a common subset of images we all use and if members want to test additional images for their devices that might have larger gamuts. Ms. Alessi stated that their images would be both hardcopy prints and a CD. Ms. McDowell suggested that uses the TC130 images would confuse the images because people were already used to seeing them a certain way.

Mr. Katoh asked why hardcopy images were needed. Ms. Alessi stated that this helped coordinate between geographic distances and that she only needed the luminance level and primaries. Mr. Newman asked if the display needed to be calibrated. Mr. Katoh asked how RGB was defined. Mr. Alessi stated she wasn't providing RGB images. She had XYZ(D50) for a print. The goal was to provide XYZ(D93) for a display. So one first transformed XYZ to colour appearance space for both print and displays. Using the primary and white point, one iterates until the RGBs are within 0 to 1 range. Then one is assured that the images are within gamut. Mr. Katoh asked for clarification on how gamut mapping is avoided. Mr. Alessi stated that she was provided images within gamut.

Mr. Katoh summarized that it was necessary to use common images that are in gamut for typical displays and printers. He pointed out that characterizing common printers was much more difficult than displays. Mr. Newman suggested that everyone could use the hardcopy prints to compare to member printer situations. Mr. Katoh commented that this was a very kind offer. Ms. Alessi stated that they had five images in order to span a wide range of the colour gamuts, including a golfer (with grass and sky), musicians, fruit, barn and u-chart. The TC agreed to use these images. Mr. Katoh thanked Ms. Alessi for the kind offer. Ms. Alessi volunteered that she would talk with Mr. Fairchild and Mr. Luo for advice on how to make prints and what parameters of the models need to be adjusted.

4.7. Image size

Ms. Alessi asked about image size in order to make the images same size (but different resolution). Mr. Katoh stated image was between 6x8 inch and 8x10 inch and asked Ms.

Alessi which size was better. Mr. McDowell pointed out that we need to specify the resolution of the monitor.

4.8. White field at image edge

Mr. Katoh stated that he put the white field at the edge of the display image as a recommendation as a default, but noted that deviations were allowed if documents.. Ms. Alessi stated that this helped eliminate the cognitive effects and improved chromatic adaptation.

4.9. Which display white points to use

Mr. Katoh suggested 9300 Kelvin and other optionally. Ms. Alessi suggested that everyone agree to use at least 9300. Mr. Schanda suggested that 6500 was a good choice. Mr. Katoh chose 9300 because it was common and the most challenging Mr. Newman asked what white point is expected to be common in the future Mr. Katoh Sony will continue to attempt to meet the needs of its customers and both 6500 and 9300 are commonly requested. Therefore we recommend both 9300 and 6500 as default white points with other white points optional.

4.10. Which hardcopy white points and lamps to use

Mr. Katoh stated that most Japanese office standards use either CIE F2 or F6. He asked what is normal in US and Europe? Ms. Billger answered Sweden uses warmer lighting. Mr. Newman stated Americans are resistant to using fluorescent lighting the home, so tungsten or CIE Illuminant A are most common in US homes. Mr. Schanda stated European homes commonly use both tungsten and compact fluorescent lighting. Ms. Billger stated daylight lighting through windows is also common.

Mr. Katoh requested volunteers to provide typical lighting in offices in US and Europe. Mr. Schanda will check with lighting manufacturers to determine what their most popular lighting types are. Mr. Stokes will provide recommendations on US office lighting. Mr. Newman suggested that this effort will probably result in one standard for Japan, one for the US and one for Europe. Ms. Alessi suggested it would be helpful to use only a single lighting default for the office. Mr. Stokes suggest the TC choose the middle white point if three different choices are provided. Mr. Katoh suggested the white points of F2 and F6 are very similar. Mr. Newman asked what the difference in metamerism was between these lights. Mr. Schanda volunteered to check on these differences and also on what lamps are available to the committee members. Mr. Katoh suggested the TC needs more investigation in this area. Mr. Schanda commented that we must decide between three band and continuous spectral distribution lamps. Mr. Katoh

noted that each member must measure the actual lamp used instead of theoretical CIE illuminants. Mr. McDowell suggested we use sources recommended by Mr. Schanda after preliminary investigation was complete. Mr. Stokes volunteered to send US office information to Mr. Schanda. Mr. Katoh volunteered to send Japan office information to Mr. Schanda. Mr. Schanda will take this information, along with his Europe office information and pick an available lamp close to these to use in the experiments. Mr. Katoh concluded that the TC will pick preferred lamp and use close to that lamp and should report actual lamp spectra in the experimental report. Mr. Schanda asked if we should test under target source and suggested that we identify a preferred lamp and spectral power distribution and strive to use something close to this preferred target and record the actual spectral power distribution of the lamp used.

<note> After consulting other illumination experts in CIE, F11 is most commonly used all over the world. It is three-narrow-band type fluorescent (see CIE 15.2 for its spectral distribution).

4.11. Luminance

Mr. Katoh asked if there were any more comments on luminance. TC members had no more comments on this topic. Mr. Katoh suggested that any deviations from the recommendations should be noted in the experimental report.

4.12. Hardcopy position and viewing angle

Mr. Newman asked what angle the hardcopy should be held relative to the lighting and display. Mr. Katoh reviewed the experimental instructions from his previously article. The major constraint was that the hardcopy not be held next to the display, but it could be held at angle. Mr. Newman suggested it was important for the committee to specify the angle of the hardcopy relative to the lighting and display. Ms. Alessi suggested that the print could be mounted at a fixed angle. Mr. Katoh suggested this approach presented experimental difficulties when many prints were used. Mr. Schanda asked for clarification and a short, lively discussion followed. Mr. Katoh concluded the discussion by concluding the hardcopy angle relative to the lighting and display should be no greater than 45 degrees and this also help exclude the specular component that incurs gloss and thus make judging more difficult.

4.13. Color Vision testing of observers

Ms Wenzel suggested that observers should be tested for color vision and volunteered to send the committee a set of digital images to perform such a test. Mr. Katoh thanked Ms. Wenzel for her kind offer and the TC agreed to use these images as a baseline vision test.

4.14. Number of observers

Mr. Katoh asked how many observers should be required. Ms. Alessi suggested at least 20. Mr. Katoh asked if more than five observers were enough. Ms. Alessi suggested her experience in CIE TC1-27 indicated that at least 15 observers were needed. TC members agreed to use at least 15 observers

4.15. Observer population characteristics

Ms. Wenzel suggested that we try to have well distributed, representative sampling of observers with respect to age, sex and experience. In any event, the age, sex and experience of each observer would be recorded. TC members agreed this was a good idea.

4.16. Experimental method

Mr. Katoh commented that the abbreviations used in the experimental guidelines were derived from Ms. Braun's paper. Ms. Alessi suggested we agree upon using a single method and that be simultaneous binocular method (SBM) with both display and hardcopy in the field of view. Mr. Newman suggested this method be called "near simultaneous binocular method" to indicate both images were in the field of view, but not side by side, thus requiring eye movement to view each image.

<Ref> K. M. Braun, et al., "Viewing Techniques for Cross-Media Image Comparisons," Color Res. Appl. 21, 6-17 (1996)

4.17. Control of duration of observer focus

Mr. Yaguchi asked if it was necessary to control the duration of focus on each image since this impacted adaptation. Mr. Stokes agreed with Mr. Yaguchi's comment that duration of focus was important and suggested that any tendency be noted in experimental records.

4.18. Hardcopy/Softcopy Image distance separation

Ms. Alessi asked what the recommended image separate distance would be. Mr. Katoh suggested that fixing image positioning precisely leads to practical experiment difficulties and he would prefer not to limit this too much. Mr. Katoh noted that proper device characterization was important and all agreed.

4.19. Room Geometry

Mr. Newman and Ms. Billger suggested that room geometry lighting was important. Ms. Alessi and Ms. Billger suggest the TC use diffuse top lighting and all agreed.

4.20. Which chromatic adaptation models used in image preparation

Ms. Alessi asked which chromatic adaptation models would be used. Mr. Katoh asked if it was necessary to standardize upon a single model. Ms Alessi indicated that a small limited set of models was necessary to optimize image production. Mr. Katoh suggested use of the model from his previous work. Mr. Newman suggested use of CIE recommended CIECAM97s and CIECAM97s2. Ms. Alessi suggested that this set of three models was acceptable.

<note> TC chair will send an e-mail for clarification of this topic, later.

4.21. Review of basic experimental goals

Mr. Newman asked to review basic question which experiment answers. Ms. Alessi noted that this is the best way to start work. Mr. Schanda commented that we are all supposed to report back that "I found at X percentage of adaptation between the two illuminant the best match"

4.22. Levels of percentages of adaptation to test

Ms. Kucsera asked if more than six levels of percentage of adaptation of prints were needed. Mr. Stokes felt that six levels were enough.

4.23. Number of print sample sets to prepare

Ms. Wenzel asked how many sets of prints were needed. Mr. Katoh counted five experimental sites from members in the room. Mr Newman suggested that 10 sets of prints were needed. TC members agreed this was reasonable.

5. Schedule for experiments

5.1. Expected starting date of experiments

Mr. Katoh noted that members had previously agreed to start experiments in the fall on 1999 and asked if this was still agreeable.

5.2. experimental preparations

Ms. Alessi volunteered that she could possibly produce the images by October 1999 if she received the lamp information from Ms. Schanda by the first of September 1999. The TC members agreed to start experiments in late October or November.

6. Conclusions:

- It was agreed that Ms. Pirrotta's and Ms. Oskoui's methods and experiments could be considered as a subset within CIE TC8-04 terms of reference and the TC welcomed the inclusion of their work within the committee.
- Image size will be between 6x8 inch and 8x10 inch.
- Both 9300 and 6500 as default display white points with other white points optional.
- The TC will pick preferred lamp and use close to the default lamp <F11> and should report actual lamp spectra in the experimental report.
- The hardcopy angle relative to the lighting and display should be no greater than 45 degrees and this also help exclude the specular component that incurs gloss and thus make judging more difficult.
- TC members agreed to test observers' colour vision using Ms. Wenzel's images.
- TC members agreed to use at least 15 observers
- It was agreed to strive to have a well distributed, representative sampling of observers with respect to age, sex and experience. In any event, the age, sex and experience of each observer would be recorded.
- TC members agreed to use "near simultaneous binocular method" to indicate both images were in the field of view, but not side by side, thus requiring eye movement to view each image.
- It was agreed to use diffuse top lighting and all agreed.
- Mr. Alessi agreed to use the models S-LMS <Katoh's>, CIECAM97s and CIECAM97s2 in her image preparation.
- The TC members agreed to start experiments in late October or November.
- It was agreed that 10 sets of prints were needed.

7. Action Items:

- Mr. Stokes to ask Ms. Oskoui and Ms. Pirrotta to share their experimental results with TC as soon as possible
- Ms. Alessi volunteered to help provide such imagery with photographic prints. In particular, it was agreed to create 10 sets of prints and attempt to distribute them in October.
- Ms. Alessi volunteered that she would talk with Mr. Fairchild and Mr. Luo for advice on how to make prints and what parameters of the models need to be adjusted.
- Mr. Schanda will check with lighting manufacturers to determine what their most popular lighting types are.
- Mr. Stokes will provide recommendations on US office lighting.
- Mr. Katoh volunteered to provide recommendations on Japan office lighting.
- Mr. Schanda volunteered to check on the metamerism differences and also on what lamps are available to the committee members.
- Mr. Schanda will take this information, along with his Europe office information and pick an available lamp close to these to use in the experiments.
- Ms Wenzel suggested that observers should be tested for color vision and volunteered to send the committee a set of digital images to perform such a test.

8. Closing

Mr. Katoh thanked all the meeting participants and closed the meeting.