Journal of Contemporary Psychological Research
ISSN 2349-5642(Print) ISSN 2455-0981 (Online) Vol.3 Issue 2 August 2016

Sex-related Differences in Hue Discrimination: A Computer-Based Experimental Study

Sairaj M. Patki*
Dept of Psychology,
Modern College of Arts, Science and Commerce
Pune (Maharashtra)

Abstract

The existence of sex-related differences in human visual processing capabilities, especially color perception has been a matter of debate, though findings in the favor of the fairer sex have pre-dominated the research scenario. The present study thus investigated sex-related differences in hue discrimination through a computerized experiment. After screening participants for color blindness, the final sample comprised of 80 participants (40 males and 40 females) in the age range 18 – 25 years. The stimuli comprising of 24 randomly presented color patches (12 identical and 12 with slight alterations). The hypothesis stating that women perform better on hue discrimination tasks than men was tested using t-Test. Statistical analysis performed using SPSS ver.22 software showed no sex-related differences in number of correct responses and average response time.

Keywords: *Hue discrimination, sex-related differences, computer-based experiment*

*Dr. Sairaj M. Patki is an Assistant Professor in Psychology at the post-graduate section of the Department of Psychology, Modern College of Arts, Science, and Commerce, Shivajinagar, Pune. He is a contributory faculty at the Department of Psychology, Savitribai Phule University and has been a faculty at Symbiosis College of Arts and Commerce, Pune.

The author may be contacted at Building no. B-8, Flat no. 1, Meeranagar Co-op. Housing Society, Lane 7, Koregaon Park, Pune-411001, 020-26150864 (R),

Email: sairaj.patki@gmail.com.

The physiological explanation for sex-related differences in color vision is based upon sexual dimorphisms in the genes that encode the X-linked cone photo pigments, thus manifesting different frequencies of expression in men and women (Pardo et al., 2007). The proposition that males and females differ perceptually or cognitively in their color experience however, may simply be a result of divergent patterns of socialization for males and females, greater verbal skills or interest in colors instilled in women (Anyan & Quillian, 1971).

The existence of sex-related differences in terms of human visual processing capabilities has been a controversial issue, with available literature abundant with mixed evidences. On one hand, certain studies have shown sex-related differences in human color vision. At a psychological level, there appear to be a number of higher order cognitive differences between males and females. For instance, studies on color lexicon indicate that females have a larger word repertoire than males and that they use more elaborate terms to describe colors (Nowaczyk, 1982; Simpson & Tarrant, 1991). Studies also show that females are better at matching colors from memory (Pe´rez-Carpinell, Baldovi, de Fez, & Castro, 1998). These differences have been observed across languages and cultures (Thomas, Curtis, & Bolton, 1978) and could be due to the differential social patterns followed by males and females (Bimler, Kirkland, & Jameson, 2003). According to Hurlbert and Ling, the sex-related differences in color vision could be attributed to the evolution of society, where females were the gatherers (while men were the hunters) and thus needed better color discrimination to detect reddish fruits against a green foliage (Hurlbert & Ling, 2007). A recent study by Jain and colleagues (Jain et al., 2010) too showed that females can see more shades of colors than males. However, there are other studies which have shown no major differences. For instance, Pickford's study (1951) showed that male color vision is the same as that of females; while the study using Farnsworth-Munsell 100-Hue test by Verriest, Vandevyvere, and Vanderdonck (1962) too showed no sex-related differences. All these studies were conducted manually.

Literature thus suggests no clear evidence in support of either the presence or absence of sex-related differences in color vision. Also, color-perception research are typically performed using pseudo-isochromatic plates or a standardized hue test such as the Farnsworth 100-Hue. With the advent of programmable computerized experiments, testing such problems that rely heavily upon procedural and measurement accuracy has not only become possible, but also practically more viable and methodologically sounder. Manually conducted experiments, especially while studying psychophysical problems, leave much room for measurement error, lower reliability of results and are also more time consuming and labor intensive. The present study thus investigated hue discrimination capabilities across the genders through a computerized experiment. Hue discrimination capability was assessed on the basis of the number of correct discriminations and on the basis of the response time.

Hypotheses

Based upon the available literature, indicating sex-related differences in human vision hue-discrimination, the following hypotheses were framed for the present study -

H_1: Number of correct responses on the hue-discrimination task will be more in female participants than in male participants.

H_2: Response time on the hue-discrimination task will be less in female participants than in male participants.

Method

Participant Characteristics

The sample for the present study comprised of 80 participants (40 males and 40 females) in the age range 18 – 25 years. The minimum educational level was Std. X^{th}, while the maximum was Post-graduation. All participants for the experiment were well familiar with the use of laptops.

Sampling

Convenience sampling technique was used for the present study. All participants were initially screened for color blindness using Ishihara cards, and one male participant who failed the test was not included in the experiment.

Research Design

The present study was a comparative study and the between-groups design was utilized for the same. After assessing adherence to assumptions, independent samples t-test was performed using SPSS Version 22.

Independent variable: The hue patches (same vs. different) presented on the laptop screen

Grouping variable: Sex of the participant

Dependent variables:

a) Number of correct responses
b) Response time

Control variables:

a) Possible color blindness of the participants was controlled by screening the participants for color blindness using Ishihara cards.
b) Randomization method was used for the presentation of the stimuli to control habituation, presentation order bias, expectancy, etc.

Measures and Covariates

The material for the experiment comprised of a laptop, the computerized experiment for testing hue-discrimination capability designed by the researcher using Open Sesame (version 2.9.2) software, and images of 24 color patches (12 identical and 12 with 5% hue alteration in the same direction created using Adobe Photoshop Version CS3 Extended), representing the basic colors of the color wheel. The computerized experiment was designed in a manner to display the instructions to the subjects, then display the 24 hue patches in a randomized manner, collect the responses of the subjects (pressing 'S' to register a response that the two patches are the same, and 'D' to register a response in the other direction), and generate an Excel sheet of the response time taken by the subjects to press the key and register each response, and the number of correct responses.

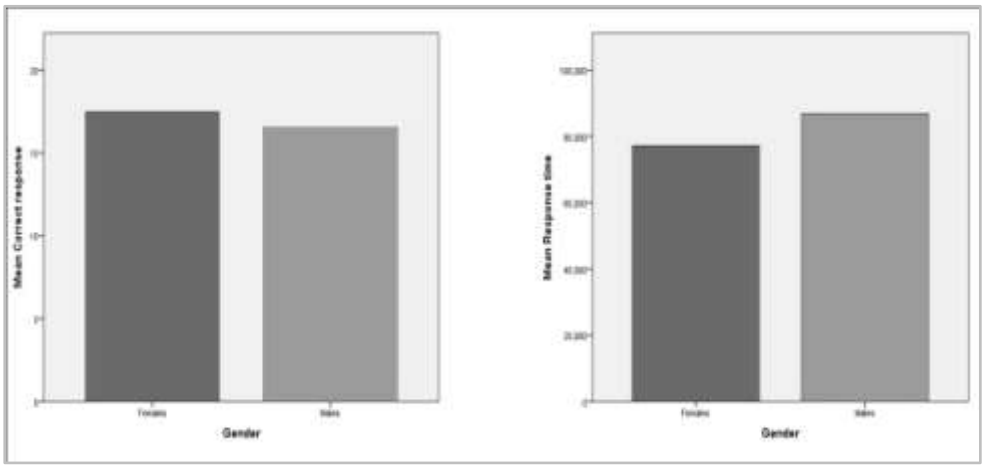
Results

Table 1 Summary of *t*-test for Sex-wise Comparison on Number of Correct Responses and Response Time (*n* = 40 each)

		n	Mean	S.D.	*t*
CR	Males	40	16.53	2.953	-1.574 (NS)
	Females	40	17.48	2.418	
RT	Males	40	77170.30	39908.45	1.047 (NS)
	Females	40	86844.90	42690.37	

Key: NS = not significant ($p > .05$), CR = Number of correct responses, RT = Response time (in milliseconds)

Figure 1 Sex-wise Comparison on Number of Correct Responses and Response Time (*n* = 40 each)



Discussion

The findings of the present study revealed no significant sex-related differences in the number of correct responses or response time on the hue discrimination task, thus requiring the rejection of both the hypotheses framed for the study. In some earlier studies too, where male–female differences have been observed, the effects were insignificant. A study by Rodriguez Carmona and colleagues (Rodriguez Carmona et al., 2008) on 302 participants (150 males with median age 28 years and 152 females with median age 24 years) too demonstrated a lack of significant difference. The researchers used Nagel Type 1 anomaloscope, investigated a number of red/green mixture ratios in order to establish the extreme ends of the range until the subject was unable to match the two hemifields. The number of scale units between the matching limits was recorded as the matching range. The midpoint was then recorded as the midpoint value of the red/green matching range, and then used to compare hue discrimination. Another recent study by

Čebatorienė1 and Liutkevičienė (2014) showed similar results. The study examined 66 female and 34 male participants. Except in 76 - 85 years age group (where males performed better than females), the performance of males and females on the best and worst color sense task using F-M 100 hue test was absolutely the same.

Conclusion and Implications

The present experimental study demonstrated no significant differences in hue discrimination between males and females. The computerized nature of the study gave it an advantage over previous such experiments by eliminating any possible aberrations in administrative process and response time recordings. The experiment designed in the study can be used for investigating other color vision problems too. The study not only has generated some empirical evidence for lack of significant sex-related differences in hue discrimination, but also has indicated a possible revolution in experimental psychology wherein findings of problems tested decades ago can be tested and critically evaluated with the help of technology-backed research designs and tools.

References

Anyan, W. R. Jr. & Quillian, W. W. I. (1971). The naming of primary colors by children. *Child Development,* 42, 1629-1632.

Bimler, D. L., Kirkland, J., & Jameson, K. A. (2003). Quantifying variations in personal color spaces: Are there sex differences in color vision? *Color Research & Applications,* 29, 128–134.

Čebatorienė1, D., & Liutkevičienė, R. (2014, November 27-28). *Best and worse color sense discrimination in males and females by different age groups.* Paper presented at the 18th International Conference Biomedical Engineering, Kaunas, Lithuania.

Hurlbert, A. C., & Ling, Y. (2007). Biological components of sex differences in color preference. *Current Biology,* 17, 623–625.

Jain, N., Verma, P., Mittal, S., Singh, A. K., & Munjal, S. (2010). Gender based alteration in color perception. *Indian Journal of Physiology and Pharmacology,* 54 (4), 366-370.

Nowaczyk, R. H. (1982). Sex-related differences in the color lexicon. *Language & Speech,* 25, 257–265.

Pardo, P. J., Perez, A. L., & Suero, M. I. (2007). An example of sex-linked color vision differences. Color Research & Application 32, 433-439.

Pe´rez-Carpinell, J., Baldovi, R., de Fez, M. D., & Castro, J. (1998). Color memory matching. Time effect and other factors. Color Research & Applications, 23, 234–247.

Pickford, R. (1951). *Individual differences in colour vision.* London: Routledge and Kegan Paul.

Rodriguez-Carmona, M., Sharpe, L. T., Harlow, J. A., & Barbur, J. L. (2008). Sex-related differences in chromatic sensitivity. *Visual Neuroscience,* 25, 433–440.

Simpson, J., & Tarrant, A. W. (1991). Sex- and age related differences in colour vocabulary. *Language & Speech,* 34, 57–62.

Thomas, L. L., Curtis, A. T., & Bolton, R. (1978). Sex differences in elicited color lexicon size. *Perceptual & Motor Skills,* 42, 77–78.

Verriest, G., Vandevyvere, R., & Vanderdonck, R. (1962). Nouvelles recherches se rapportant a l'influence du sexe et de l'age sur la discrimination chromatique ainsi qu'a la signification pratique des resultats du Test 100 Hue de Farnsworth-Munsell. Revue d'Optique, 41, 499–509.