Journal of Life Sciences 5 (2011) 772-775

Effect of the Chromatic Assimilation (Bezold Effect) in the Vision of the Content on a Dinner Plate

Ignacio Tortajada[1], Jorge Montalvá[2] and Mariano Aguilar[2]

1. Department of Graphic Engineering, Universidad Politécnica de Valencia, Valencia 46022, España

2. Escuela Técnica Superior de Ingeniería del Diseño, Universidad Politécnica de Valencia, Valencia 46022, España

Received: November 25, 2010 / Accepted: April 08, 2011 / Published: September 30, 2011.

Abstract: The color perception on a dinner plate depends on the color and distribution of the surrounding content. It is unthinkable to eat a typical Spanish dish, paella blue, or drink red or green milk. The color is also an indicator of expiration. The color of food intake predisposes us, which is known as the phrase “eat with our eyes” while we see an appetizing menu. Besides, the importance of the composition of a dish, distribution and presentation is critical in their perception. We are working long time in the lab of The Engineering Design Faculty on the perception of the distribution of objects, especially on the Bezold effect. It is interesting to apply the results of the perception that people have of the distribution of food, anchovies, olives, potatoes, etc. on a plate. To carry out this work we have used people who show the human reaction to the various situations described. Most relevant results, we note that the background (e.g. dish, decoration) with a horizontal grating, the effect of chromatic assimilation is greater than the vertical orientation, regardless of the orientation of the sequence.

Key words: Bezold effect, color vision, chromatic perception.

1. Introduction

Daily experience shows that in the perception of a color, the surrounding areas or the areas intercalated in the object, have a great influence. In most cases this influence makes the object vary towards the complementary color of these disturbing areas, and this variation is known as simultaneous and spatial contrast (to distinguish it from temporary contrasts in the post-images) or chromatic contrast. If the disturbing areas (surround) are achromatic (white, grey or black), the contrast makes the object look darker or lighter.

With certain spatial distributions, the colors intercalated can add to the object. This fact originally discovered by Chevreul [1] and subsequently described by Bezold [2], is known as Bezold effect [3], assimilation effect [4], expansion effect or simply chromatic assimilation.

Without denying the possibility that the expansion effect could be justified physiologically as Hurvich and Jameson [5] claim, due to the existence of receiving units of different sizes in the area where the image is formed, we believe this effect can be explained psychologically as per Gestalt theory [6]. According to this theory [7], the vision is a consequence of the brain’s interpretation of radiant energy received from the total visual field. We always see objects as part of the set they are in (for example, in a marine landscape, any distant object will always be a boat.).

Many authors have intented to justify the Bezold effect, while for the study of the simultaneous contrast, the justifications are consistent in the scientific community, no such clear justification has been found for the assimilation effect. Burnham [8] made his experiences with drawings based on the original Bezold plates, noting that the Bezold effect appears by viewing displays with a lack of sharp focus. Helson [9]

Corresponding author: Ignacio Tortajada, Ph.D., research fields: color management, Bezold effect. E-mail: itortajada@dig.upv.es.

claimed that assimilation occurs when there are small differences between inducing and test areas. On the other hand, Helson [10] says that assimilation occurs when the inducing region is small relative to the test region.

In our laboratory we are working on the same way as: Agostini and Galmonte [11], Bressan [12], White [13], and Gilchrist [14]. Because we believe that the Bezold effect can not be justified by the contrast theories. We have followed this line of research since 2001, showing the results in the different congresses of the IAC: Rochester [15], Granada [16], and Stockholm [17], and more recently our work in Color Research & Application [18] with the acceptance of the document.

2. Materials and Methods

The tests have three grey straight parallel sequences with a width equal to their separation (1 cm), these sequences have a Ronchi grating with 2 cm period covering 22 cm diameter of the circle in the background. The central sequence is superimposed over the red stripes of the grating and the lateral ones over the white stripes (Fig. 1).

It was checked that the lateral sequences with squares coinciding with the white lines experienced a color variation (redness plus saturation) due to the expansion effect (redness) and the direct contrast (saturation increase). It was also checked that the central sequence with squares coinciding with the red lines experienced the opposite variation (saturation decreases and luminosity increases). Starting from a distance of 4 meters, the observers get closer (4, 3, 2, 1, 0.5 and 0 meters) until they cannot perceive any difference between the central and lateral sequences. At the time the observer is on the position "0" it is not 0 meters, is around 0.2 meters distance observer-test.

Measuring the color received from grey central sequence on a scale that goes from zero (meaning the central white sequence is not identified) to ten, the observer states, as he approaches the value (*V*) he perceived in the central sequence. Helson [9] made a similar assessment using the words from very much lighter, through equal, to very much darker. The verbal categories were translated into numbers from 1 to 9 with 5 standing for equality [10]. With that value we determine the chromatic contrast between the central and lateral sequences, such that the Bezold effect can be quantified. This expression is not exact although we get very approximated results.

$$\text{Bezold effect} = \frac{10 - V}{10}$$

All tests took place under the same conditions, same luminance (200 lux) with an incandescent lamp. The colors are red (x = 0.57; y = 0.38) and grey (x = 0.43; y = 0.44), all with the same β (β = 0.5). The observations were made by three students aged between 20 and 25 years. All of them had normal vision, making a total of 10 measurements for each observer and test.

3. Results, Conclusions and Discussion

The most interesting results are listed in Tables 1 and 2 and supported by Fig. 2, from which we deduce the following conclusions:

(1) With the horizontal Ronchi grating (orientation of the stripes) the Bezold effect obtained is an approximation, independent of orientation (Figs. 1A-1C) of the sequence object. This behavior is confirmed by the Gestalt theory in visual perception of

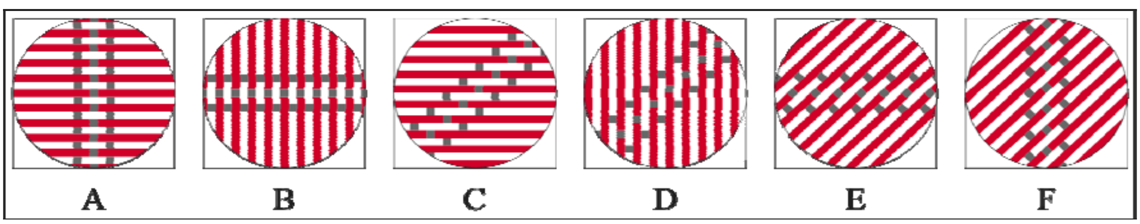

Fig. 1 Gratings used in the tests. All networks are monochromatic red-white color and achromatic sequences varying only their orientations. Only the central sequence is analyzed.

Table 1 Bezold effect on the monochromatic grating (red-white) with gray sequence in its six variables.

Separation observer-test (meters)	Grating frequency (period/degree)	Bezold effect					
		Sequence perpendicular to the grating H/V:		Grating H/V, sequence 45º inclined:		45º inclined grating, sequence H/V:	
		Grating-A (H)	Grating-B (V)	Grating-C (H)	Grating-D (V)	Sequence-E (H)	Sequence-F (V)
4	3.5	0.83	0.38	0.79	0.41	0.66	0.56
3	2.6	0.65	0.24	0.64	0.29	0.46	0.44
2	1.8	0.42	0.11	0.44	0.19	0.27	0.27
1	0.9	0.23	0.07	0.23	0.12	0.14	0.17
0.5	0.4	0.12	0.05	0.12	0.07	0.05	0.08
0	0	0.00	0.03	0.03	0.02	0.00	0.02

Table 2 Linear equations corresponding to the six variables (y = Bezold effect, x = frequency of the grating).

	Grating orientation	Sequence orientation	Linear equation
Line A	Horizontal	Vertical	$y = 0.22x + 0.03$
Line B	Vertical	Horizontal	$y = 0.11x + 0.02$
Line C	Horizontal	45º Inclined	$y = 0.22x + 0.03$
Line D	Vertical	45º Inclined	$y = 0.11x + 0.02$
Line E	45º Inclined	Horizontal	$y = 0.19x + 0.02$
Line F	45º Inclined	Vertical	$y = 0.16x + 0.02$

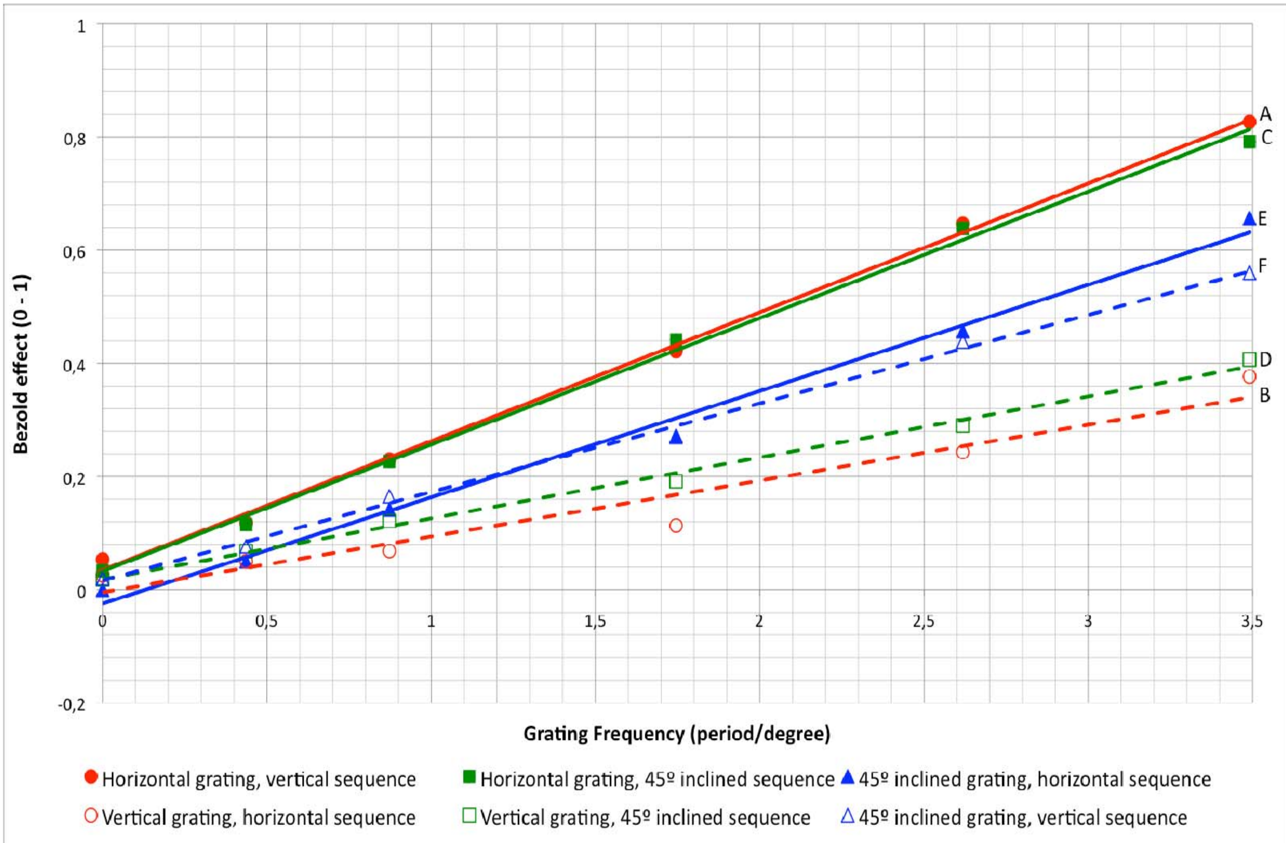

Fig. 2 Graphic representation of the Bezold effect depending on the frequency of the grating. Averages of the results obtained with the different orientations of the sequence. Nomenclature for those represented in Fig. 1 and Table 2.

objects. The fact is that the most important factor is the background (in this case Ronchi grating) in which they are embedded.

(2) The increase in the Bezold effect of the order of 0.45 (Table 1) by changing the horizontal-vertical orientation of the grating (Figs. 1A-1B) is due to the improved vision with horizontal orientation to vertical.

(3) With the 45º inclined Ronchi grating (Figs. 1E-1F) the Bezold effect, as is the case with the horizontal and vertical grating (Figs. 1B-1D), is almost independent of the orientation of the sequence.

References

[1] M.E. Chevreul, De la loi du contraste simultané des couleurs, Paris, France, 1839. (in French)

[2] W. Bezold, S.R. Koehler, E.C. Pickering, The Theory of Color in Its Relation to Art and Art-industry, Boston, United States of America, 1876.

[3] J. Albers, Interaction of Color, London, United Kingdom, 1963.

[4] R.M. Evans, An Introduction to Color, New York, United States of America, 1948.

[5] D. Jameson, L.M. Hurvich, Essay concerning color constancy, Annual Review of Psychology 40 (1989) 1-22.

[6] M. Wertheimer, Experimentelle Studien über das Sehen von Bewegung, Leipzig, Germany, 1912. (in German)

[7] E. Rubin, Visuell Wahrgenommene Figuren: Studien in Psychologischer Analyse, Berlin, Germany, 1921. (in German)

[8] R.W. Burnham, Bezold's color-mixture effect, The American Journal of Psychology 66 (1953) 377-385.

[9] H. Helson, Studies of anomalous contrast and assimilation, Journal of the Optical Society of America 53 (1963) 179-184.

[10] H. Helson, Adaptation-Level Theory, New York, United States of America, 1964.

[11] T. Agostini, A. Galmonte, Contrast and assimilation: The belongingness paradox, Review of Psychology 7 (2000) 3-7.

[12] P. Bressan, The place of white in a world of grays: A double-anchoring theory of lightness perception, Psychological Review 113 (2006) 526-553.

[13] M. White, The early history of White's illusion, Colour: Design & Creativity 7 (2010) 1-7.

[14] A. Gilchrist, C. Kossyfidis, F. Bonato, T. Agostini, J. Cataliotti, X. Li, et al., An anchoring theory of lightness perception, Psychological Review 106 (1999) 795-834.

[15] M. Aguilar, C. Urtubia, Direct and inverse contrast interaction in a periodic test viewing, in: The 9th Congress of the International Color Association, Rochester, United States of America, 2001.

[16] I. Tortajada, V. Blanca, M. Martínez, M. Aguilar, Variation with the contrast and modulation ratio of a achromatic grating on the view of a chromatic periodic test, in: 10th Congress of the International Colour Association, Granada, Spain, 2005.

[17] I. Tortajada, M. Martínez, M. Aguilar, Viewing of an achromatic test with chromatic gratings as an adaptation field, in: Interim Congress of the International Colour Association, Stockholm, Sweden, 2008.

[18] I. Tortajada, J. Montalvá, M. Aguilar, Behaviour of a periodic chromatic test with an achromatic Ronchi grating as a background, Color Research & Application, 2011. (in Press)