The Synchronous Oscillation Hypothesis

- 1) Theoretical prediction of hue of neon color effect on the basis of

the synchronous oscillation hypothesis -

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The discovery of neon color spreading "I discovered the illusion when I was working on embedded figures, trying to keep embedded figures visible for myself by coloring them, and then suddenly the neon effect became visible (Tuijl, H. F. J. M. van, personal communication; January 21, 2000).

Abstract Bressan (1995) theoretically predicted colors of the neon effect in terms of the proposal derived from Grossberg and Mingolla's model (1985). Here, we show that almost the same predictions as Bressan's ones can be obtained for hue of the neon color on the basis of the *synchronous oscillation hypothesis* that perceptual grouping and figure-ground segregation depend on synchronization of oscillations in the brain activities (Sohmiya & Sohmiya, 1976).

① If a lattice of horizontal and vertical black lines is drawn on white paper, and then certain line segments of the lattice whose removal generates illusory contour are colored, a neon-like color of the same hue as the segments appears to spread around the segments filling up the illusory area. Since the discovery of this illusory effect called 'neon color spreading' by Van Tuijl (1975), a variety of neon color displays have been derived, and at the same time the mechanisms underlying the neon effect have also been discussed fruitfully by a number of researchers. Nevertheless, the basic problem of what color appears in different color combinations of the inducing pattern and the line segments remains elusive, excluding the Bressan proposal (1995) for colors of the neon effect based on the Grossberg and Mingolla (1985).

In 1976 (Sohmiya & Sohmiya), we introduced the concept of 'pattern strength' that is large in a pattern that is hard to disappear and small in a pattern that readily disappears, on the basis of quantitative data obtained using a new experimental method for binocular rivalry named 'suppression method' (Sohmiya & Sohmiya, 1967, 1968, 1976). In addition, we proposed 'the synchronous oscillation hypothesis' that perceptual grouping and figure-ground segregation depend on the synchronous oscillation in pattern strength. Here we first propose the postulates about the degree of synchronization between colors of the inducing pattern and the line segments on the basis of the synchronous oscillation hypothesis, and then predict hues of the neon effect for 42 combinations of primary colors in the CMYK system on the basis of the postulates.

② On the basis of the synchronous oscillation hypothesis, we proposed the following postulates for their primary colors of the inducing pattern and the line segments;

1) The degree of synchronization between hues of the inducing pattern and the line segments is high in the same hues and low in different hues.

2) The degree of synchronization increases with increasing the number of hues of the inducing pattern differing to hue of the line segments.

3) The neon effect occurs associating with the degree of its desynchronization.

Table 1 illustrates the degree of synchronization of each hue of the line segments to the colors referring to the [C] of the inducing pattern and the hues of the illusory colors. When the inducers and the segments have identical colors like No.1, 7, 11, and 16, strong synchronization occurs in each hue of the two components, so that no neon effect occurs. When the hue of the segments is different in one hue to the color of the inducers like No. 2, 6, and 10, each hue of the segments is synchronized in medium degree with the color of the inducers and so the illusory color appears moderately in the same hue as the segments. When the hue of the segments is different in two hues as the [Y] of No. 8, the [Y] of the No. 9, the [M] of No. 12, and the [C] of No. 14, the degree of synchronization further decreases so that the hue of the segments appears strongly as the neon color.

Table 1 Theoretical prediction of hue of the neon color effect on the basis of the synchronous oscillation hypothesis - Referring to cyan (C) of inducing pattern -

Color of inducing pattern	Color of neon segment	Degree of synchronization	Hue of neon effect
1 [C] x [C]	→	[C] [C] [C]	No neon effect
2 [C] x [M]	→	[M]	m
3 [C] x [C]*[M]	→	[C] [M]	m
4 [C] x [M]*[Y]	→	[M] [Y]	m * y
5 [C] x [C]*[M]*[Y]	→	[C] [M] [Y]	m * y
6 [C]*[M] x [C]	→	[C]	c
7 [C]*[M] x [C]*[M]	→	[C] [M]	No neon effect
8 [C]*[M] x [C]*[Y]	→	[C] [Y]	y > c
9 [C]*[M] x [C]*[M]*[Y]	→	[C] [M] [Y]	y
10 [C]*[Y] x [C]	→	[C]	c
11 [C]*[Y] x [C]*[Y]	→	[C] [Y]	No neon effect
12 [C]*[Y] x [C]*[M]	→	[C] [M]	m > u
13 [C]*[Y] x [C]*[M]*[Y]	→	[C] [M] [Y]	m
14 [C]*[M]*[Y] x [C]	→	[C]	c
15 [C]*[M]*[Y] x [C]*[M]	→	[C] [M]	c * m
16 [C]*[M]*[Y] x [C]*[M]*[Y]	→	[C] [M] [Y]	No neon effect

C = cyan, M = magenta, Y = yellow, C*M = blue, C*Y = green, M*Y = red, C*M*Y = black, [C] [M] [Y] = high synchronization, [C] [M] [Y] medium synchronization, C, M, Y = low synchronization, y > c yellow appears stronger than cyan,

→ Synchronization ← Desynchronization

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