CHAPTER 4

RESULTS AND DISCUSSION

4.1 Visual Assessment

4.1.1 *Scoring*

The visual scores are established. They are "Light-Dark", "Soft-Hard", "Warm-Cool", "Transparent-Turbid", "Deep-Pale", "Distinct-Vague", "Heavy-Light", "Vivid-Sombre", "Strong-Weak", "Dynamic-Passive", "Gaudy-Plain" and "Striking-Subdued". Each is represented as the relationship between the results of the visual assessment and the colorimetric values in CIE $L^* C^*$ (h=90 and h=270) plane as shown in Figure 4-1 to Figure 4-12. They are described as follows:

(a) "Light-Dark" visual scores are shown in Figure 4-1. It implies that the observers assess light grey and high chroma as "Light" and assess low lightness and low chroma as "Dark".

(b) "Soft-Hard" visual scores are shown in Figure 4-2. It implies that the observers assess high lightness as "Soft" and assess low lightness as "Hard".

(c) "Warm-Cool" visual scores are shown in Figure 4-3. It implies that the observers assess color in h = 90 which has high chroma as "Warm" but the mostly of observers assess color in h = 270 as "Cool".

(d) "Transparent-Turbid" visual scores are shown in Figure 4-4. It implies that the observers assess high chroma and high lightness as "Transparent" and assess dark grey as "Turbid".

(e) "Deep-Pale" visual scores are shown in Figure 4-5. It implies that the observers assess low lightness as "Deep" and assess high lightness as "Pale".

(f) "Distinct-Vague" visual scores are shown in Figure 4-6. It implies that the observers assess high chroma as "Distinct" and assess near grey as "Vague".

(g) "Heavy-Light" visual scores are shown in Figure 4-7. It implies that the observers assess low lightness as "Heavy" and assess high lightness as "Light".

(h) "Vivid-Sombre" visual scores are shown in Figure 4-8. It implies that the observers assess high chroma as "Vivid" and assess dark grey as "Sombre".

(i) "Strong-Weak" visual scores are shown in Figure 4-9. It implies that the observers assess low lightness as "Strong" and assess high lightness as "Weak".

(j) "Dynamic-Passive" visual scores are shown in Figure 4-10. It implies that the observers assess high chroma as "Dynamic" and assess near grey as "Passive".

(k) "Gaudy-Plain" visual scores are shown in Figure 4-11. It implies that the observers assess high chroma as "Gaudy" and assess near grey as "Plain".

(l) "Striking-Subdued" visual scores are shown in Figure 4-12. It implies that the observers assess low lightness and high chroma as "Striking" and assess high lightness as "Subdued".

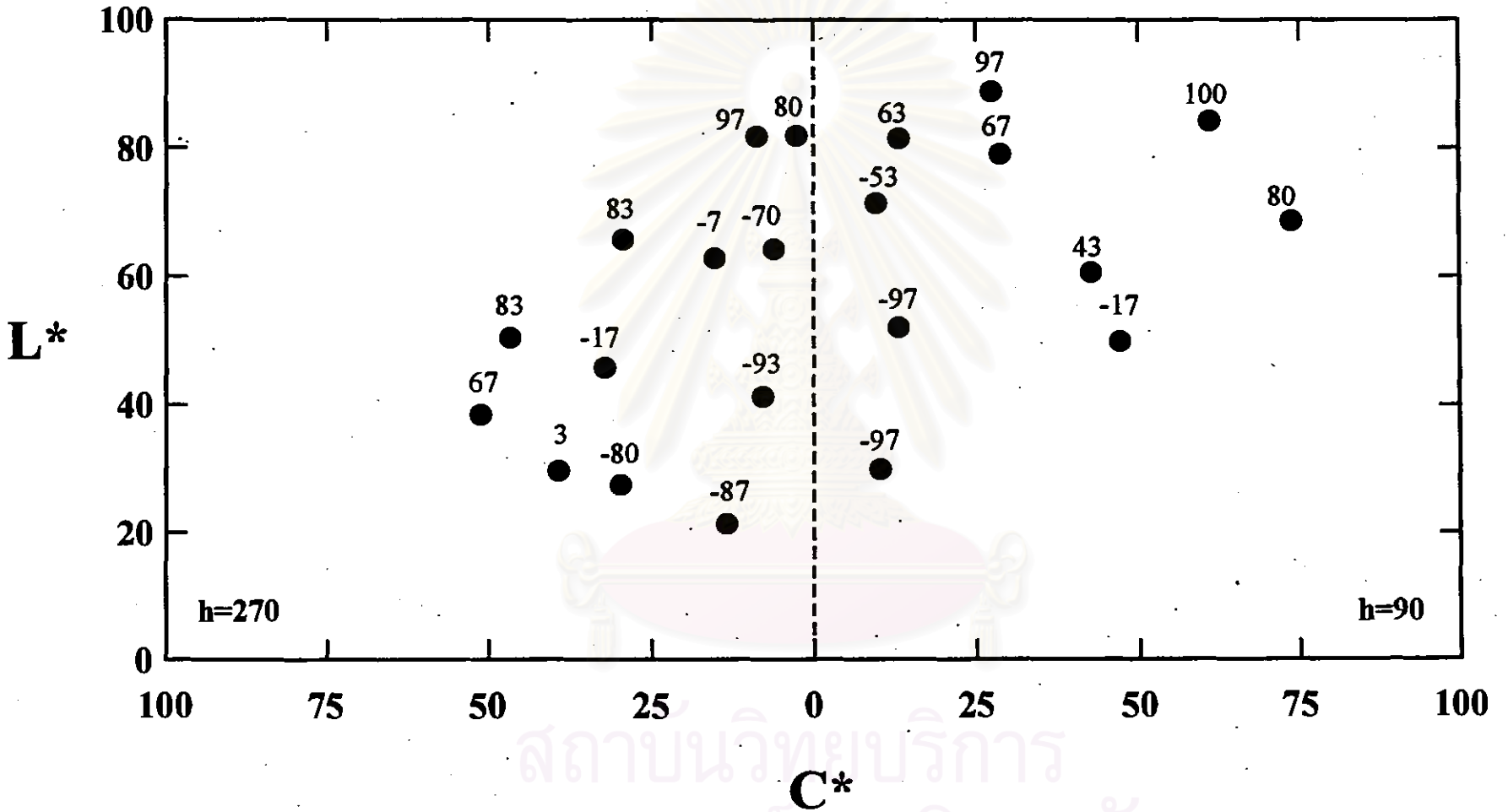


Figure 4-1 Scores plotted of "Light-Dark" on CIE L* C* (h=90 and h=270) plane

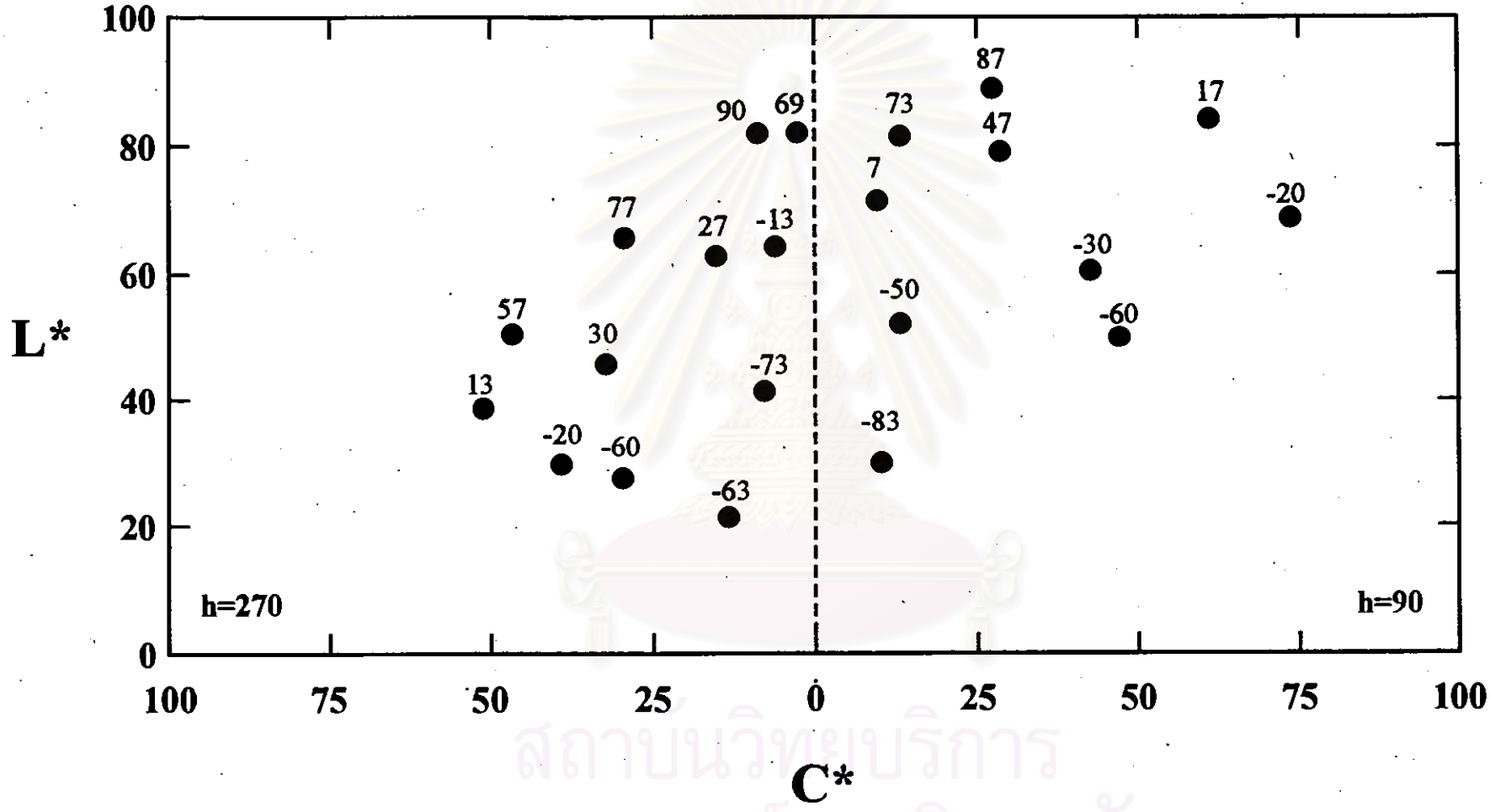


Figure 4-2 Scores plotted of "Soft - Hard" on CIE L* C* (h=90 and h=270) plane

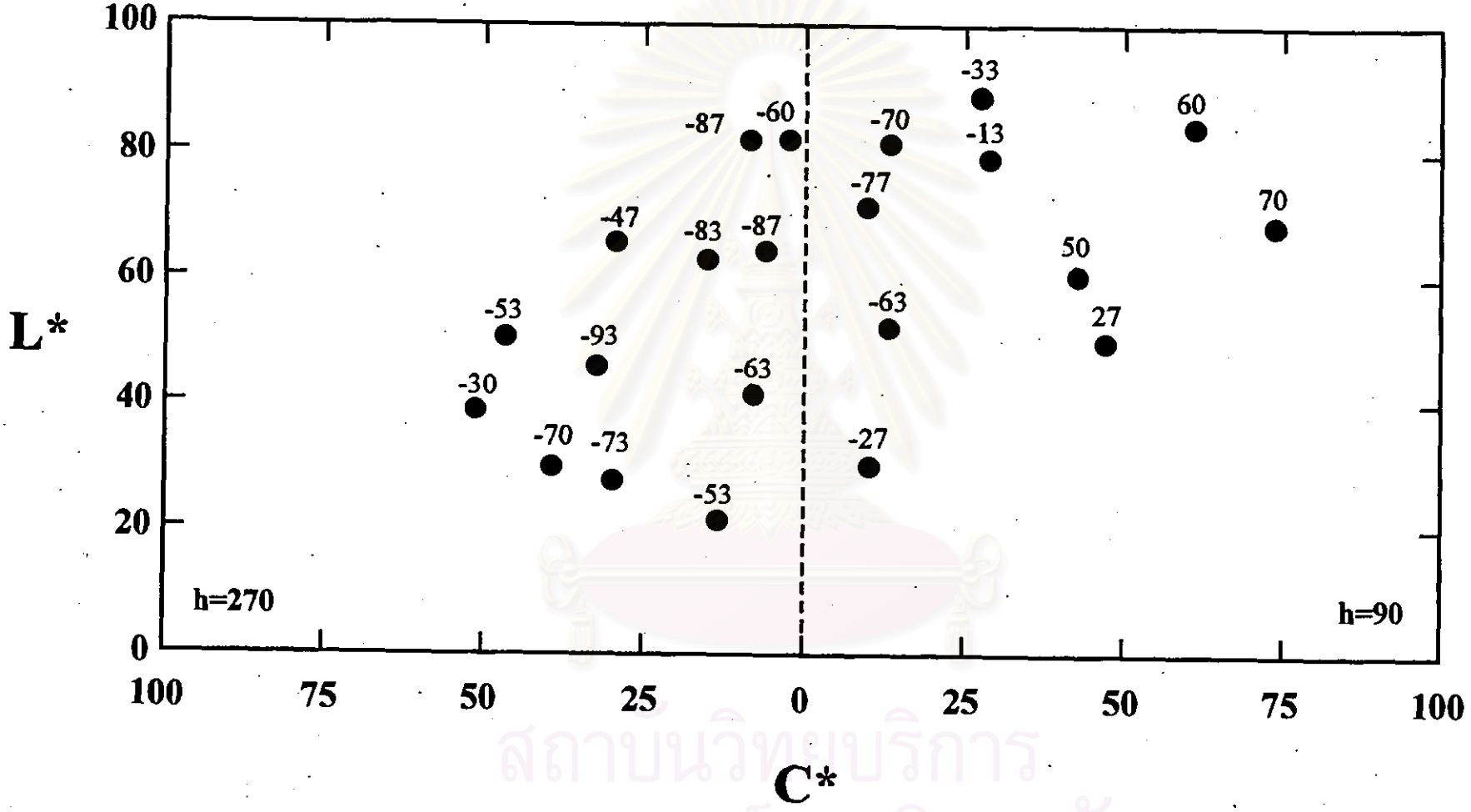


Figure 4-3 Scores plotted of "Warm - Cool" on CIE L* C* (h=90 and h=270) plane

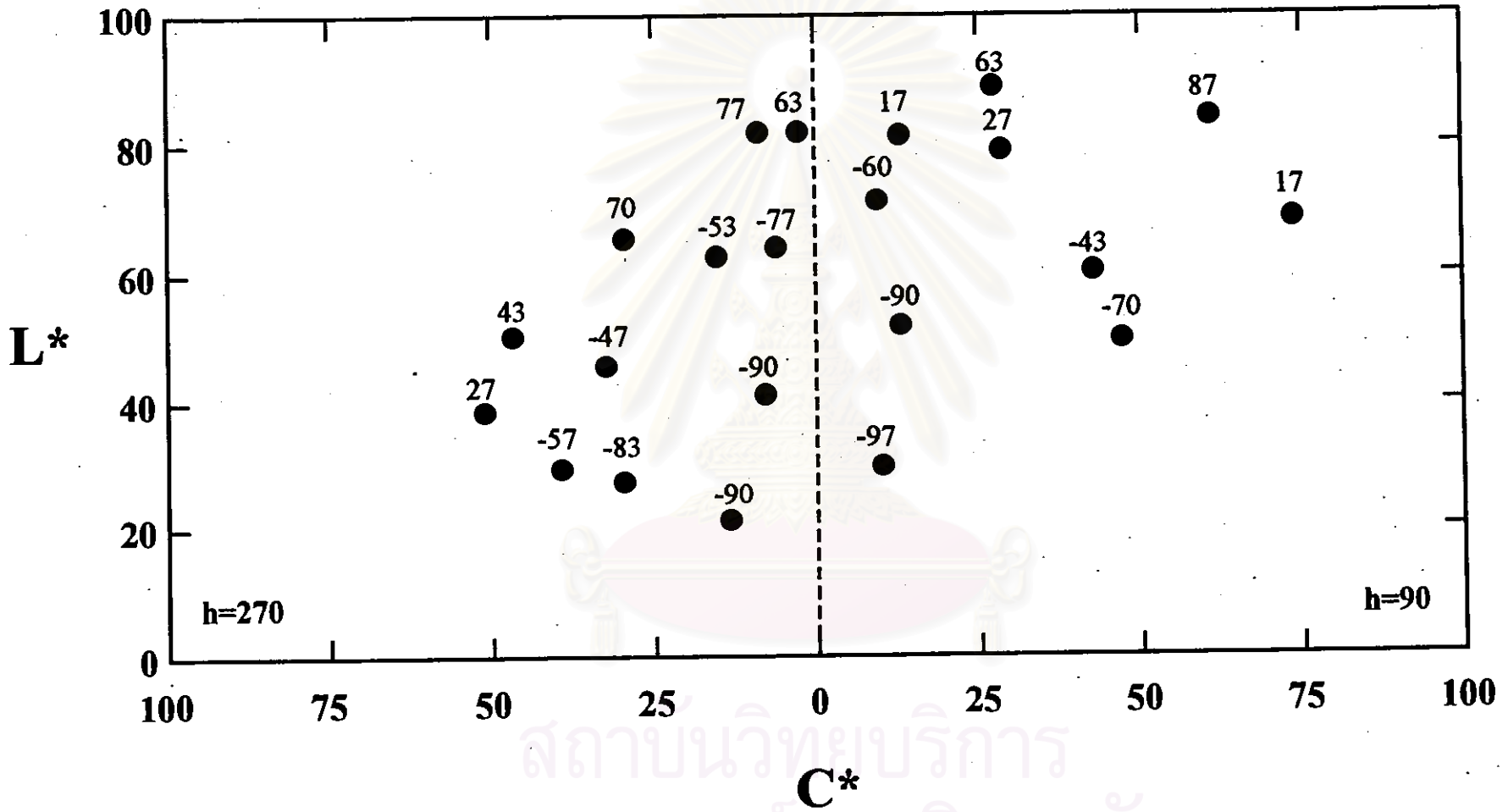


Figure 4-4 Scores plotted of "Transparent - Turbid" on CIE L* C* (h=90 and h=270) plane

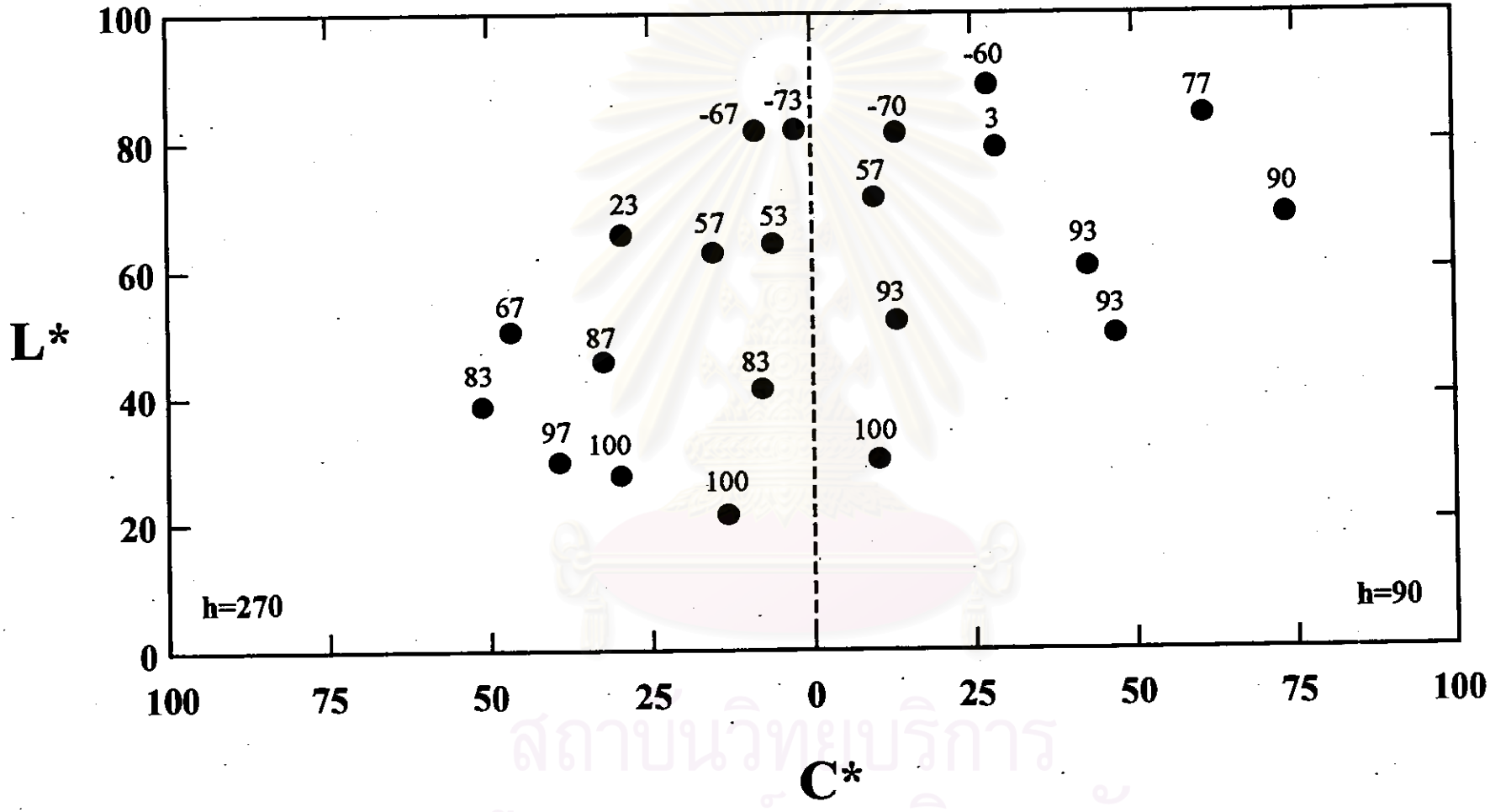


Figure 4-5 Scores plotted of "Deep - Pale" on CIE L* C* (h=90 and h=270) plane

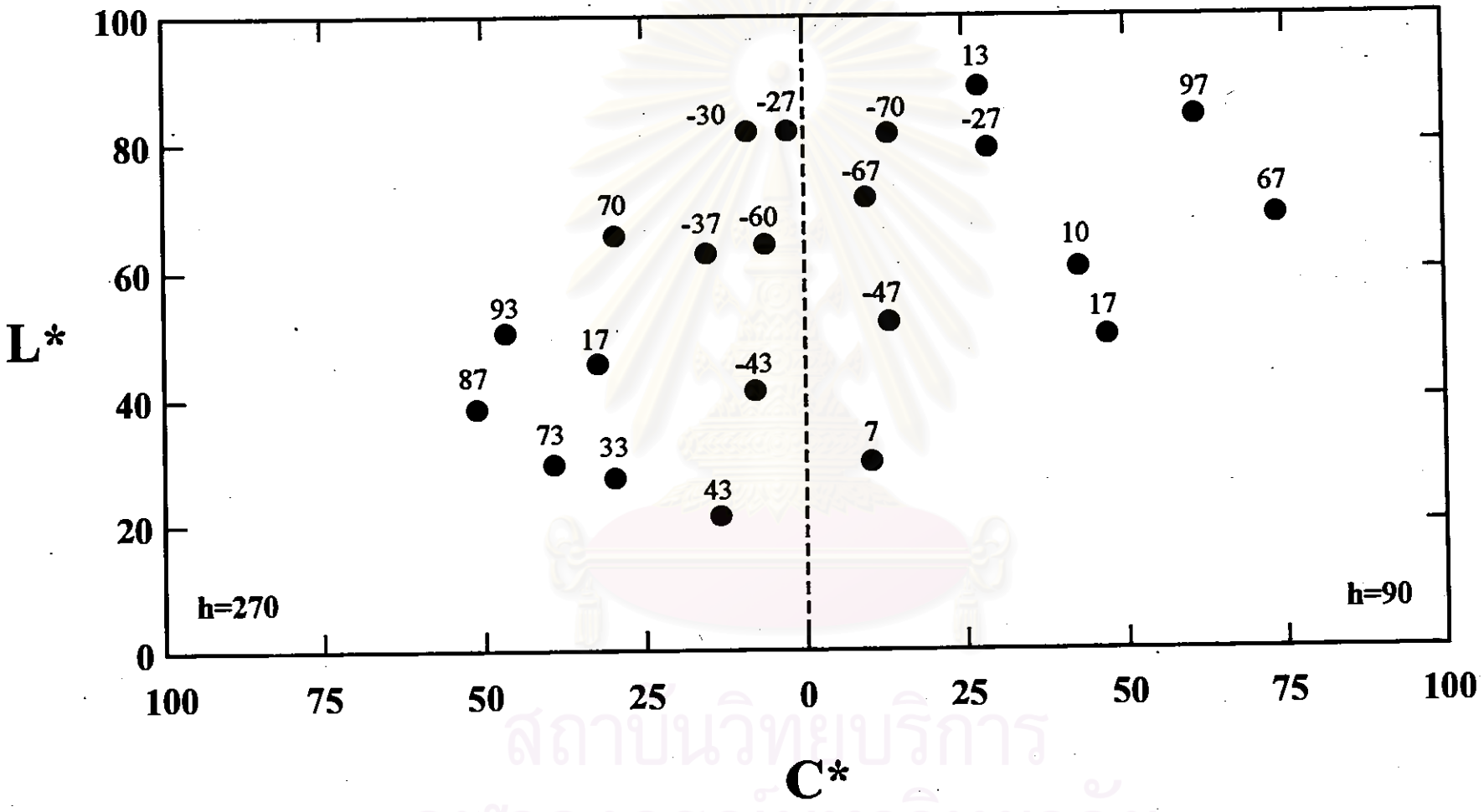


Figure 4-6 Scores plotted of "Distinct - Vague" on CIE L* C* (h=90 and h=270) plane

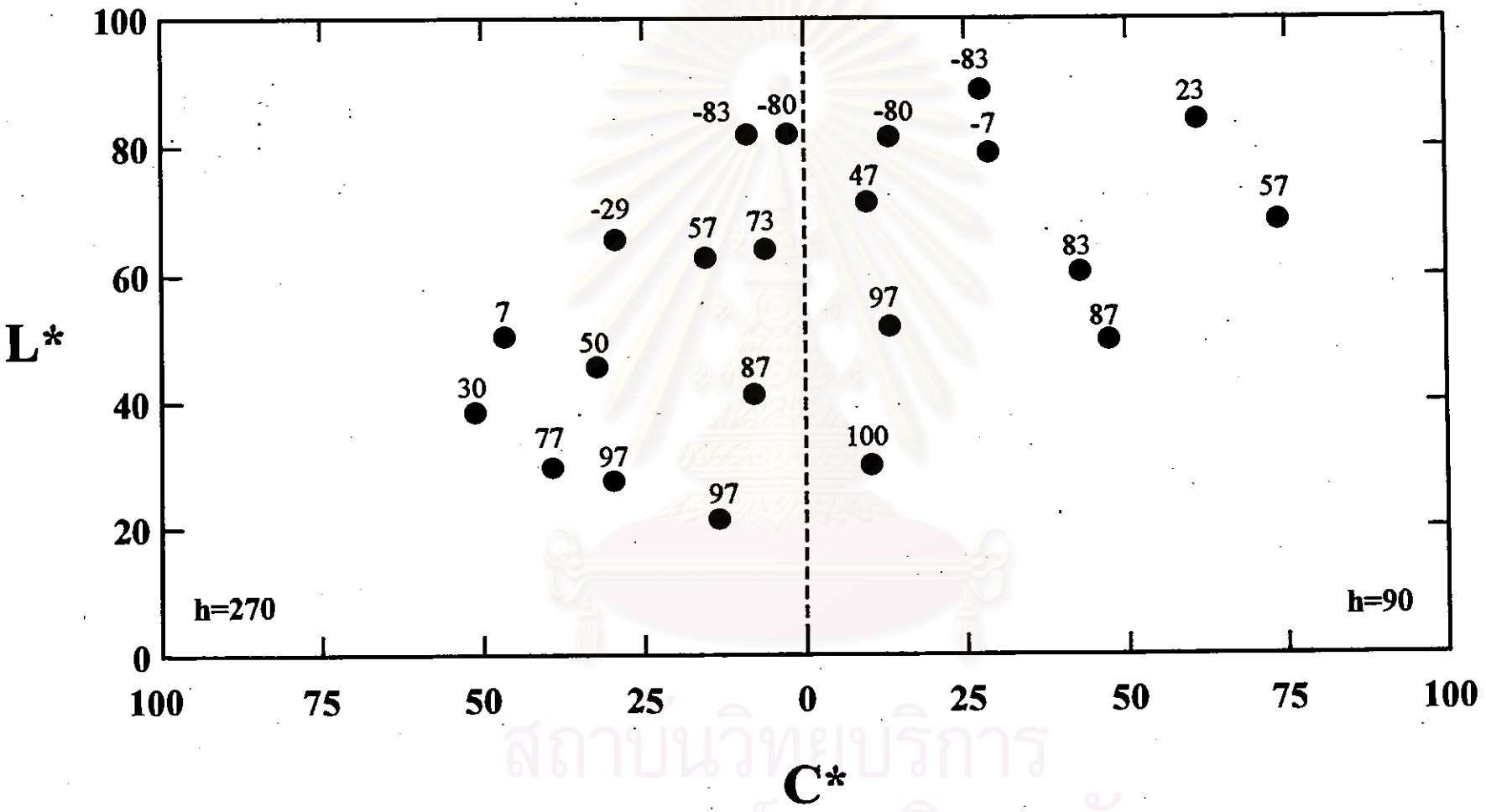


Figure 4-7 Scores plotted of "Heavy - Light" on CIE L* C* (h=90 and h=270) plane

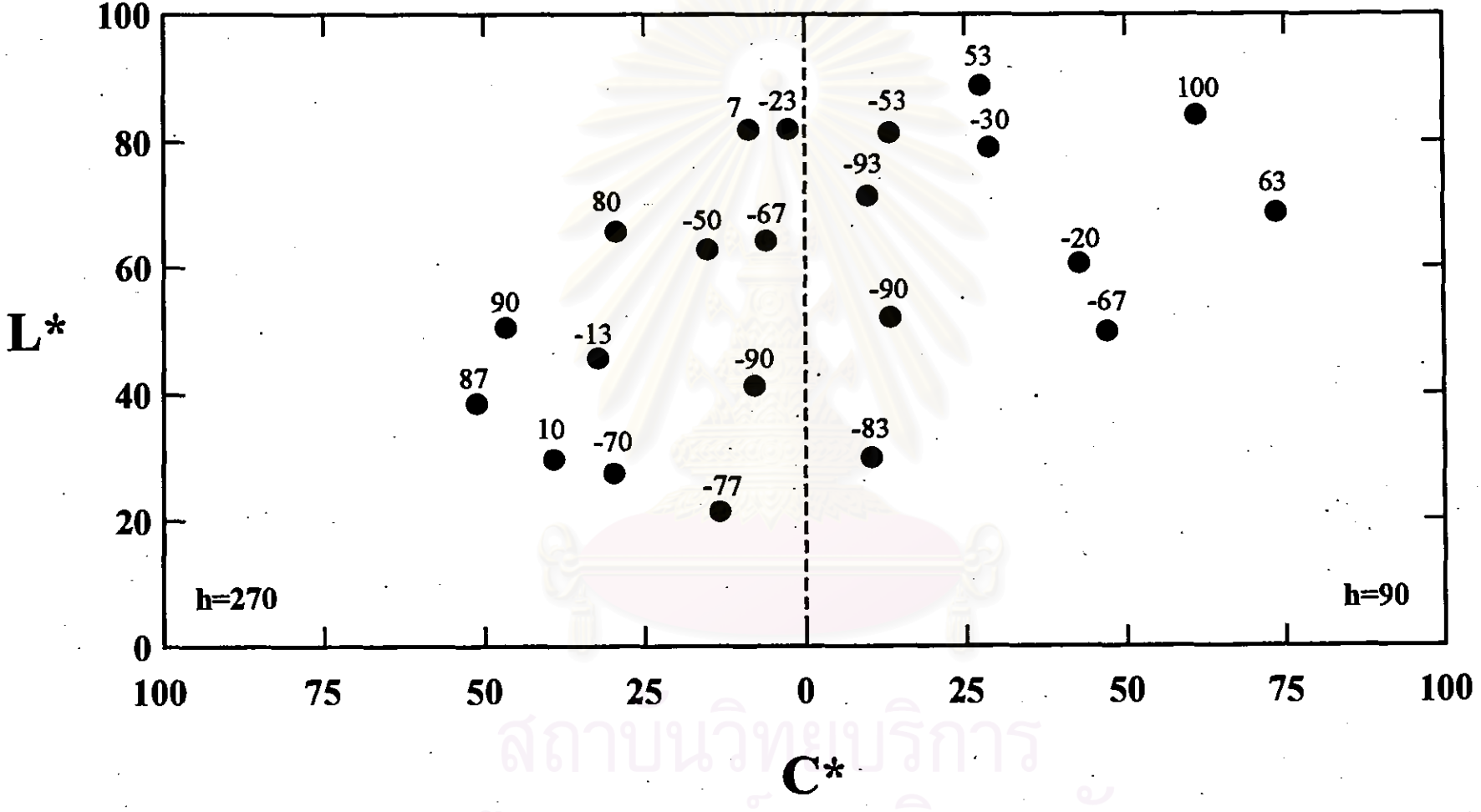


Figure 4-8 Scores plotted of "Vivid - Sombre" on CIE L* C* (h=90 and h=270) plane

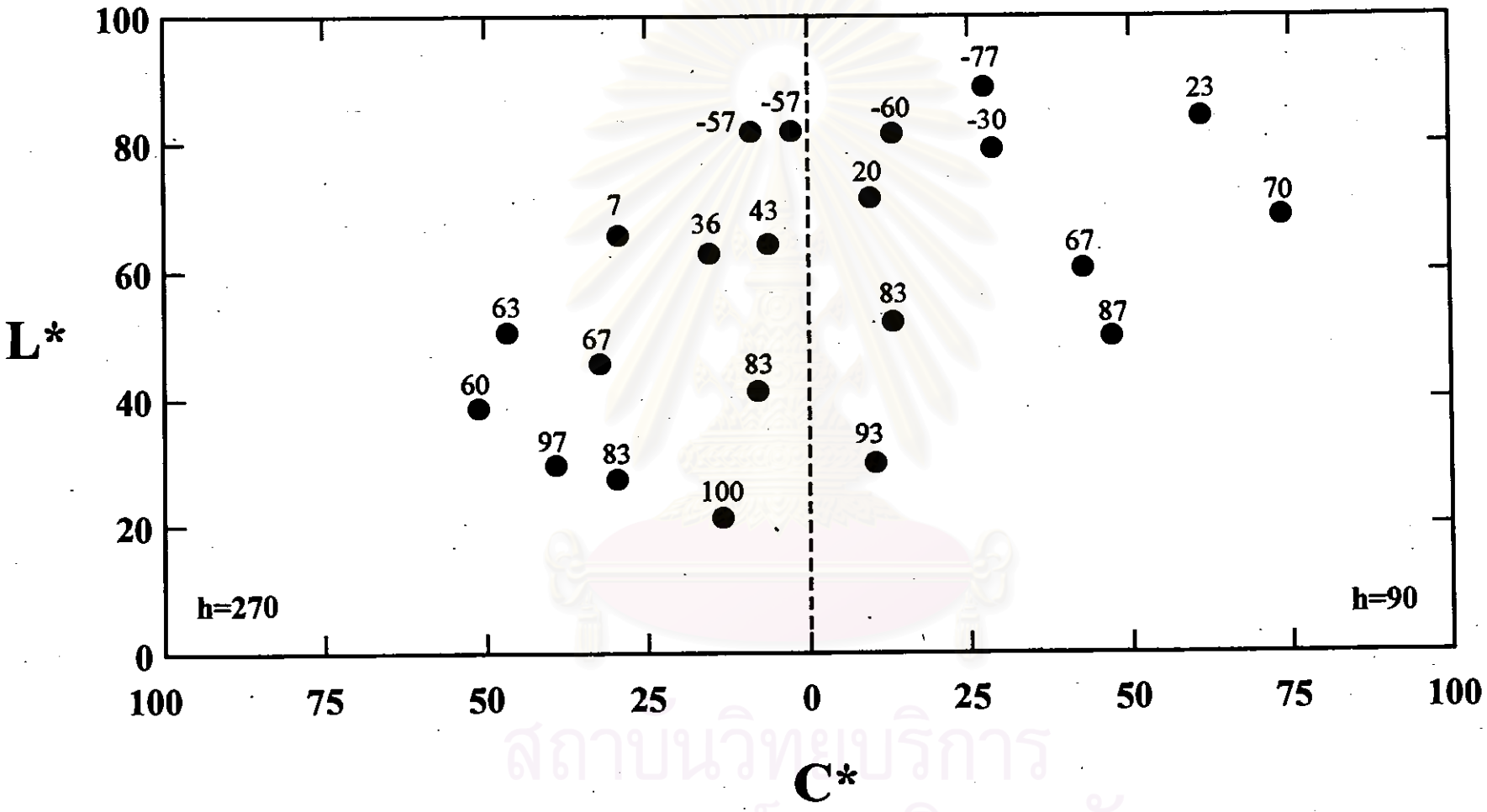


Figure 4-9 Scores plotted of "Strong - Weak" on CIE L* C* (h=90 and h=270) plane

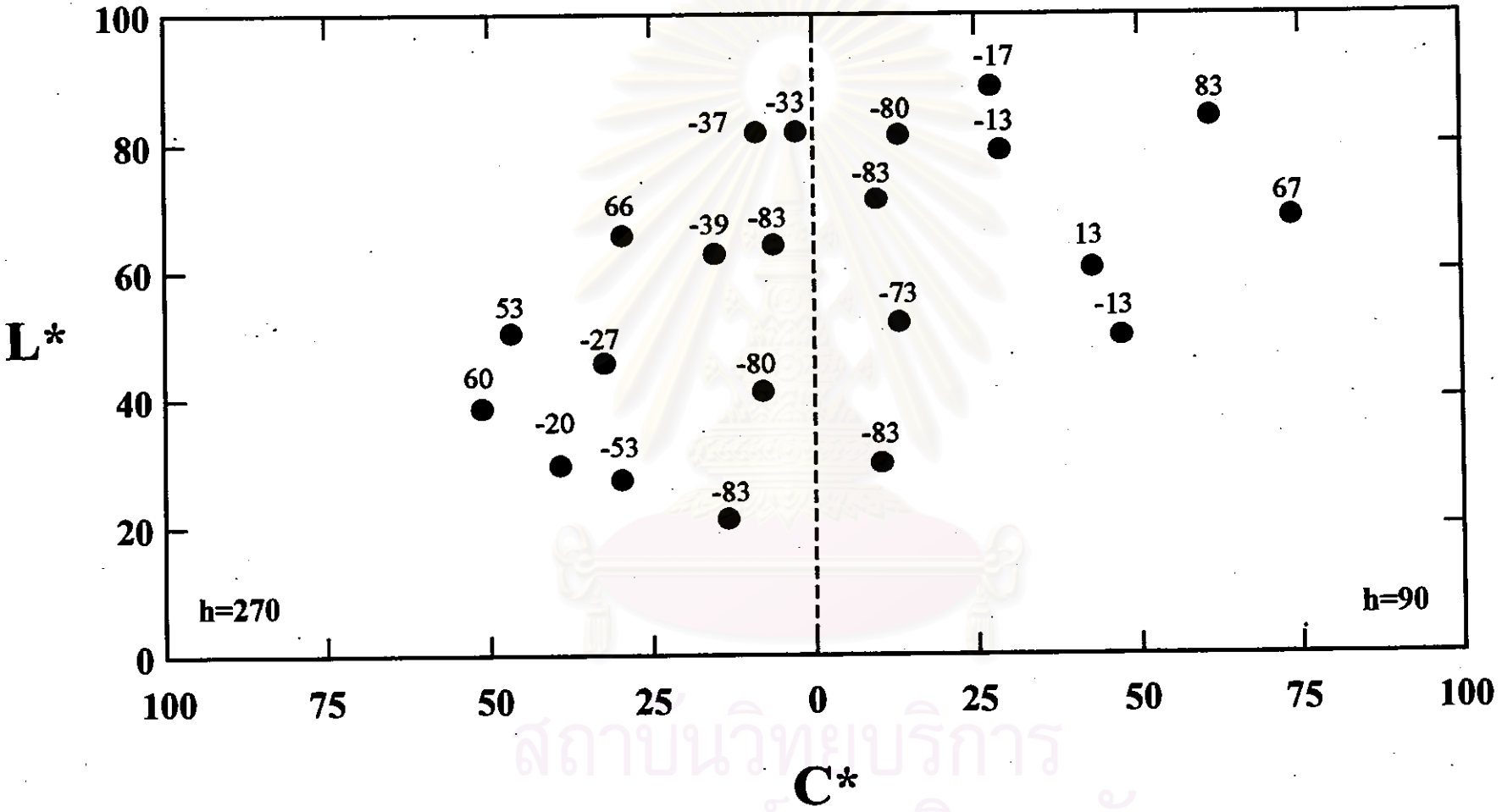


Figure 4-10 Scores plotted of "Dynamic - Passive" on CIE L* C* (h=90 and h=270) plane

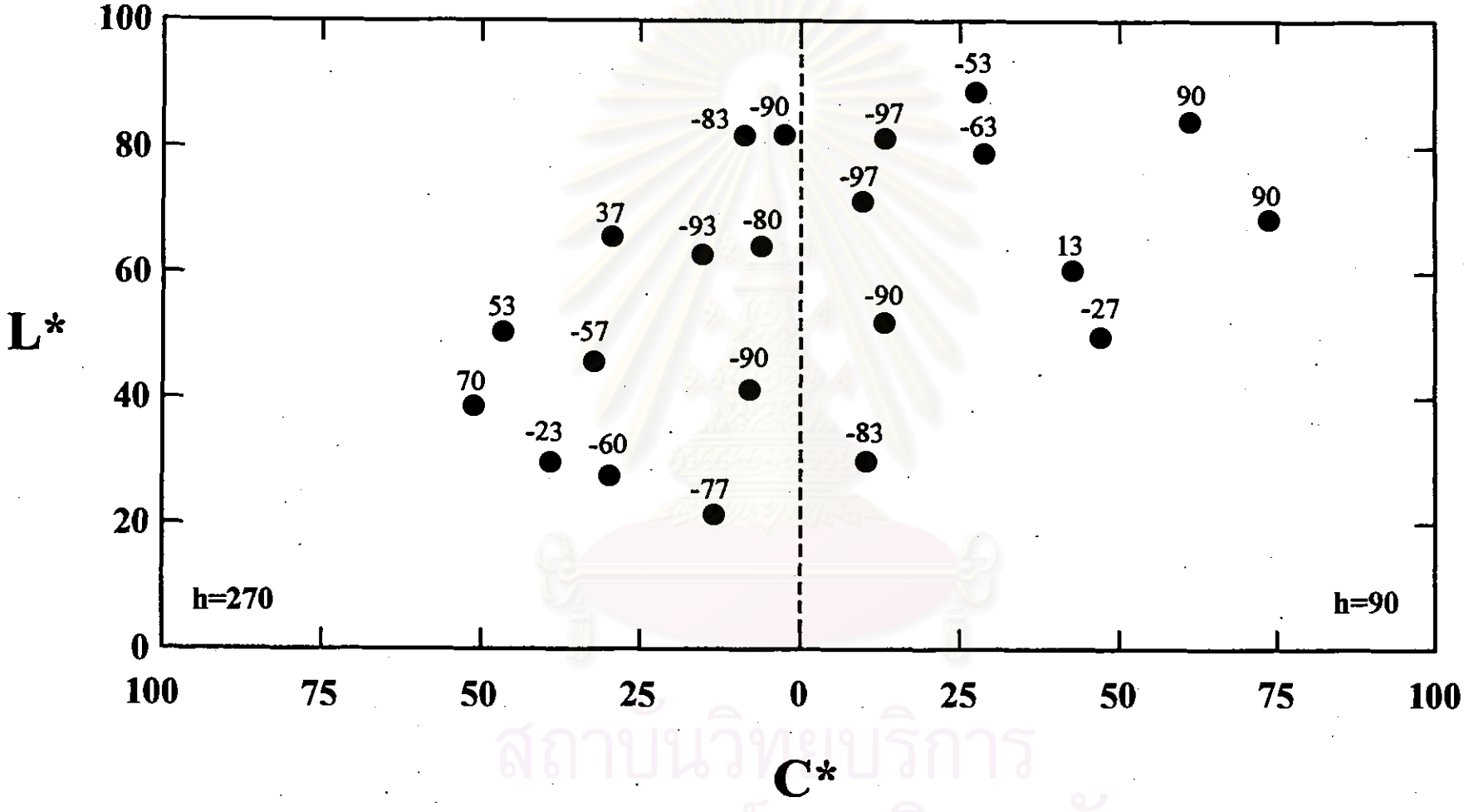


Figure 4-11 Scores plotted of "Gaudy - Plain" on CIE L* C* (h=90 and h=270) plane

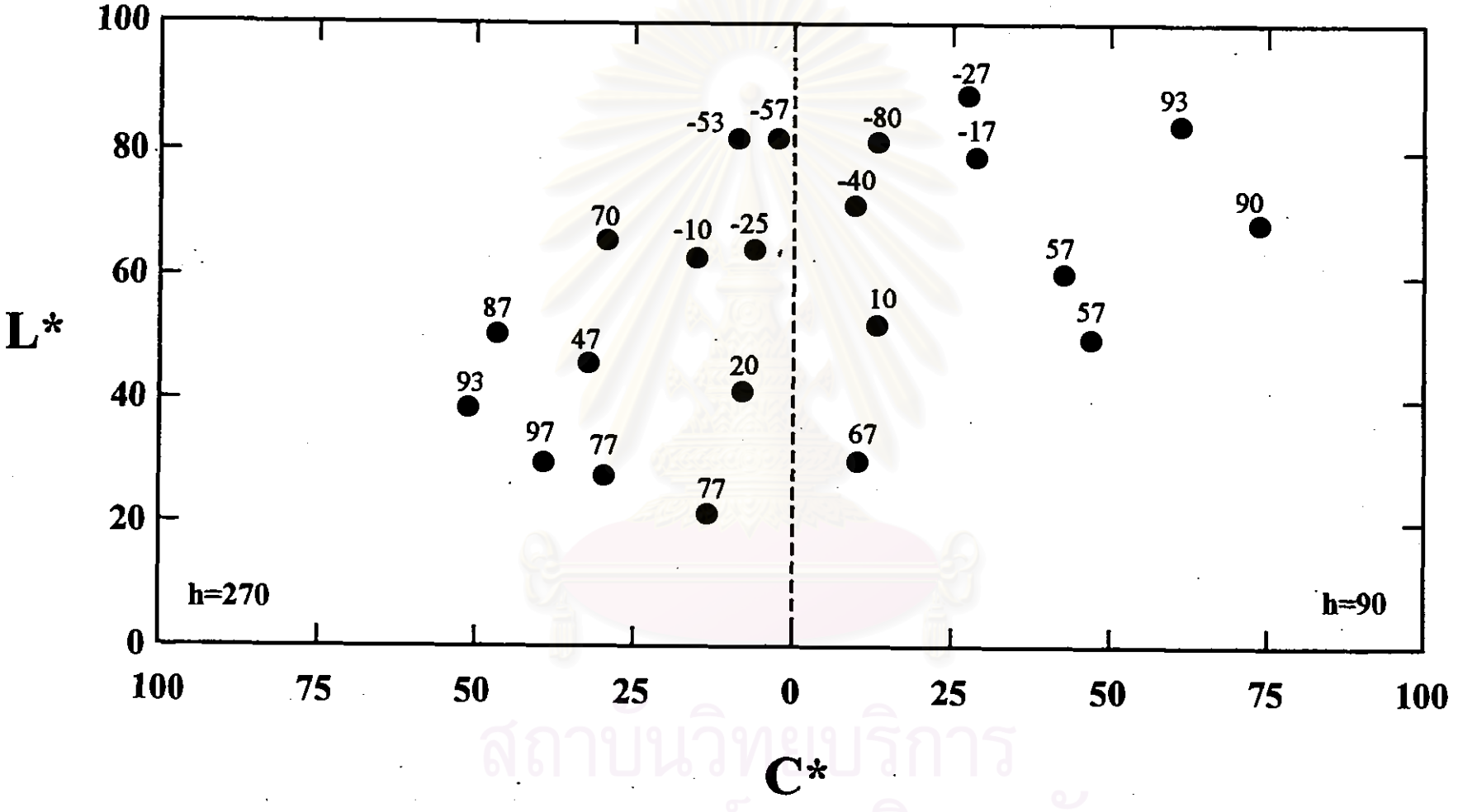


Figure 4-12 Scores plotted of "Striking - Subdued" on CIE L* C* (h=90 and h=270) plane

4.1.2 *Visual results on hue angle*

Visual results of each opponent word pairs that are relevant to hue angle are investigate as in Figure 4-13 to Figure 4-24. It is found that the distribution of visual assessment on hue angle is randomly scattered except for the case of "Warm-Cool" in Figure 4-15. The visual results of "Warm-Cool" on h = 40 are distributed much more than those of h = 220. Thus "Warm-Cool" has strong influence of hue.

4.2 Color Perception Equations

The twelve empirical color perception equations are derived based on CIE $L^* C^* h$ color system, as follows

"*Light-Dark*"

$$LD_{CIELAB} = [\{6.9(L^* - 0)\}^2+\{15.8(1-\Delta h_{290}/360)C^*\}^2]^{1/2}-500 \quad (1)$$

"*Soft-Hard*"

$$SH_{CIELAB} = -[\{3.3(L^*-100)\}^2+\{1.7(1-\Delta h_{290}/360)C^*\}^2]^{1/2}+145 \quad (2)$$

"*Warm-Cool*"

$$WC_{CIELAB} = [\{0.5(L^*-100)\}^2+\{2.6\{1+\cos(\Delta h_{40})\}(1-\Delta h_{290}/360)C^*\}^2]^{1/2}-95 \quad (3)$$

"*Transparent-Turbid*"

$$TT_{CIELAB} = [\{6.1(L^*-30)\}^2+\{5.8(1-\Delta h_{290}/360)C^*\}^2]^{1/2}-250 \quad (4)$$

"*Deep-Pale*"

$$DP_{CIELAB} = [\{5.8(L^*-100)\}^2+\{4.6(1-\Delta h_{290}/360)C^*\}^2]^{1/2}-180 \quad (5)$$

"*Distinct-Vague*"

$$DV_{CIELAB} = [\{3.6(L^*-60)\}^2+\{6.8(1-\Delta h_{290}/360)C^*\}^2]^{1/2}-120 \quad (6)$$

"*Heavy-Light*"

$$HL_{CIELAB} = [\{4.9(L^*-100)\}^2+\{2(1-\Delta h_{290}/360)C^*\}^2]^{1/2}-170 \quad (7)$$

"*Vivid-Sombre*"

$$VS_{CIELAB} = [\{4.9(L^* - 0)\}^2+\{13.2(1-\Delta h_{290}/360)C^*\}^2]^{1/2}-410 \quad (8)$$

"*Strong-Weak*"

$$SW_{CIELAB} = [\{4.15(L^*-100)\}^2+\{2.75(1-\Delta h_{290}/360)C^*\}^2]^{1/2}-140 \quad (9)$$

"*Dynamic-Passive*"

$$DYP_{CIELAB} = [\{2.7(L^*-40)\}^2+\{7(1-\Delta h_{290}/360)C^*\}^2]^{1/2}-160 \quad (10)$$

"*Gaudy-Plain*"

$$GP_{CIELAB} = [\{0.8(L^*-50)\}^2 + \{5.9(1-\Delta h_{290}/360)C^*\}^2]^{1/2}-135 \quad (11)$$

"*Striking-Subdued*"

$$SS_{CIELAB} = [\{2.5(L^*-100)\}^2+\{7.1(1-\Delta h_{290}/360)C^*\}^2]^{1/2}-130 \quad (12)$$

where

L^*: CIELAB metric lightness

C^*: CIELAB metric chroma

h : CIELAB metric hue-angle

Δh_x : CIELAB metric hue-angle difference from h=x, $0 \leq \Delta h_x \leq 180$,

The criteria to find out the accuracy of each equation is to plot the relationship between the visual results and the ones that calculated from the equations which are the tool use for predicted the color perception value. The relationship between visual results and instrumental prediction of each the opponent word pairs are shown from Figure 4-25 to Figure 4-36. The obtained correlation coefficients for all equations are over 0.900. It implies that the empirical color perception equations are acceptable.

Table 4-1 The ratios between k_1 and k_2 of the empirical color perception equations

CP	k_1	k_2	$\frac{k_1}{k_2}$
LD	6.9	15.8	0.44
SH	3.3	1.7	1.94
WC	0.5	2.6	0.19
TT	6.1	5.8	1.05
DP	5.8	4.6	1.26
DV	3.6	6.8	0.53
HL	4.9	2.0	2.45
VS	4.9	13.2	0.37
SW	4.15	2.75	1.51
DYP	2.7	7.0	0.39
GP	0.8	5.9	0.14
SS	2.5	7.1	0.35

The ratios between k_1 and k_2 of the empirical color perception equations are given in Table 4-1. The higher the values of k_1 and k_2 are, the greater the contribution of L^* and C^* to the color perception value.. Base on this explanation, it implies that "Light-Dark", "Distinct-Vague", "Vivid-Sombre", "Dynamic-Passive" and "Strinking-Subdued" contain the contributions from both lightness and chroma. Interestingly, chroma seem to be more effective than lightness. Equal contribution of lightness and chroma is found for "Transparent-Turbid". "Soft-Hard", "Deep-Pale", "Heavy-Light" and Strong-Weak" contain more contribution of lightness than chroma, while "Warm-Cool" and "Gaudy-Plain" contain more contribution of chroma than lightness. However, it should be noted that the contribution of hue effects dominantly only in case of "Warm-Cool".

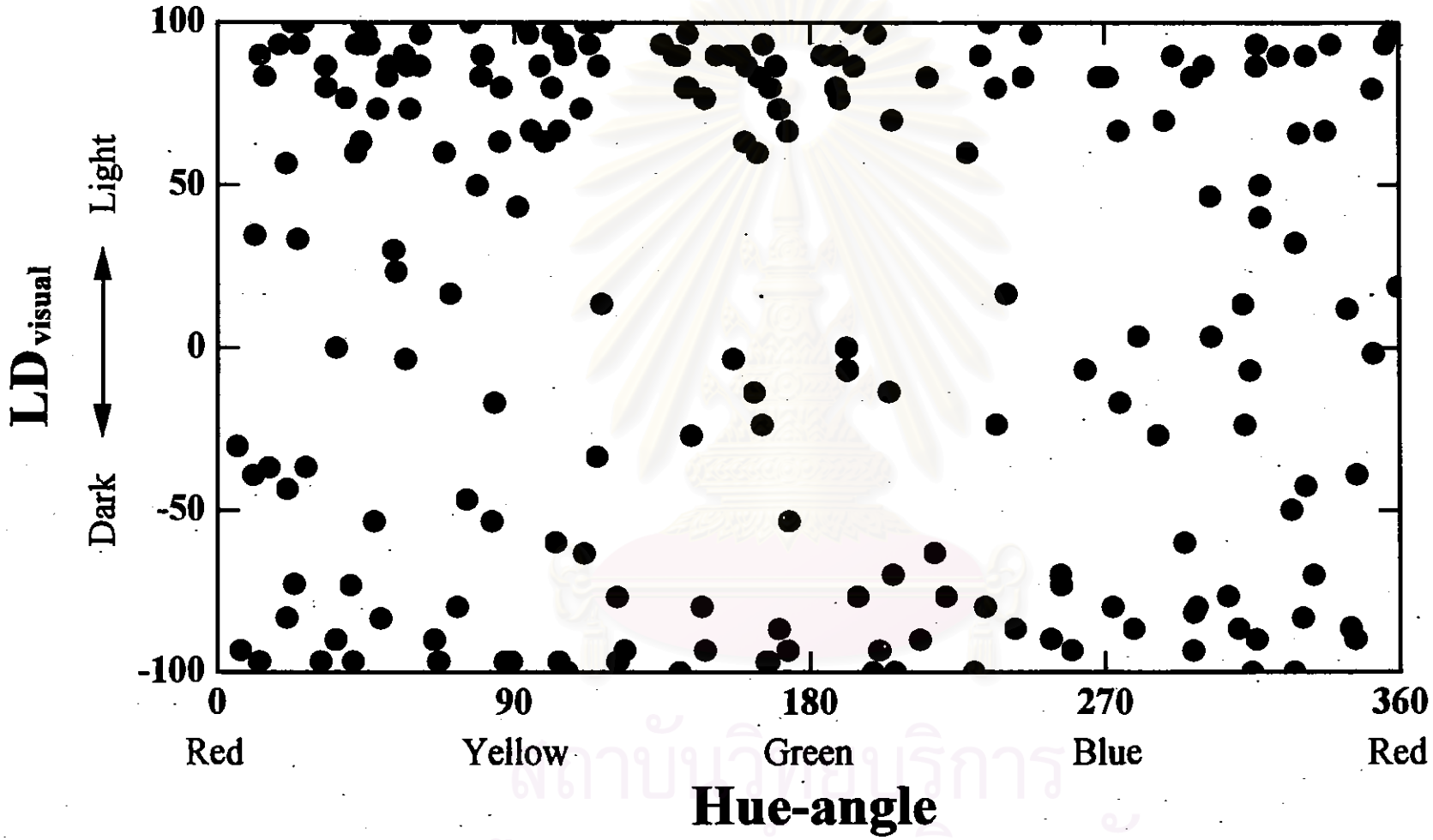


Figure 4-13 Visual results of "Light-Dark" on Hue-angle

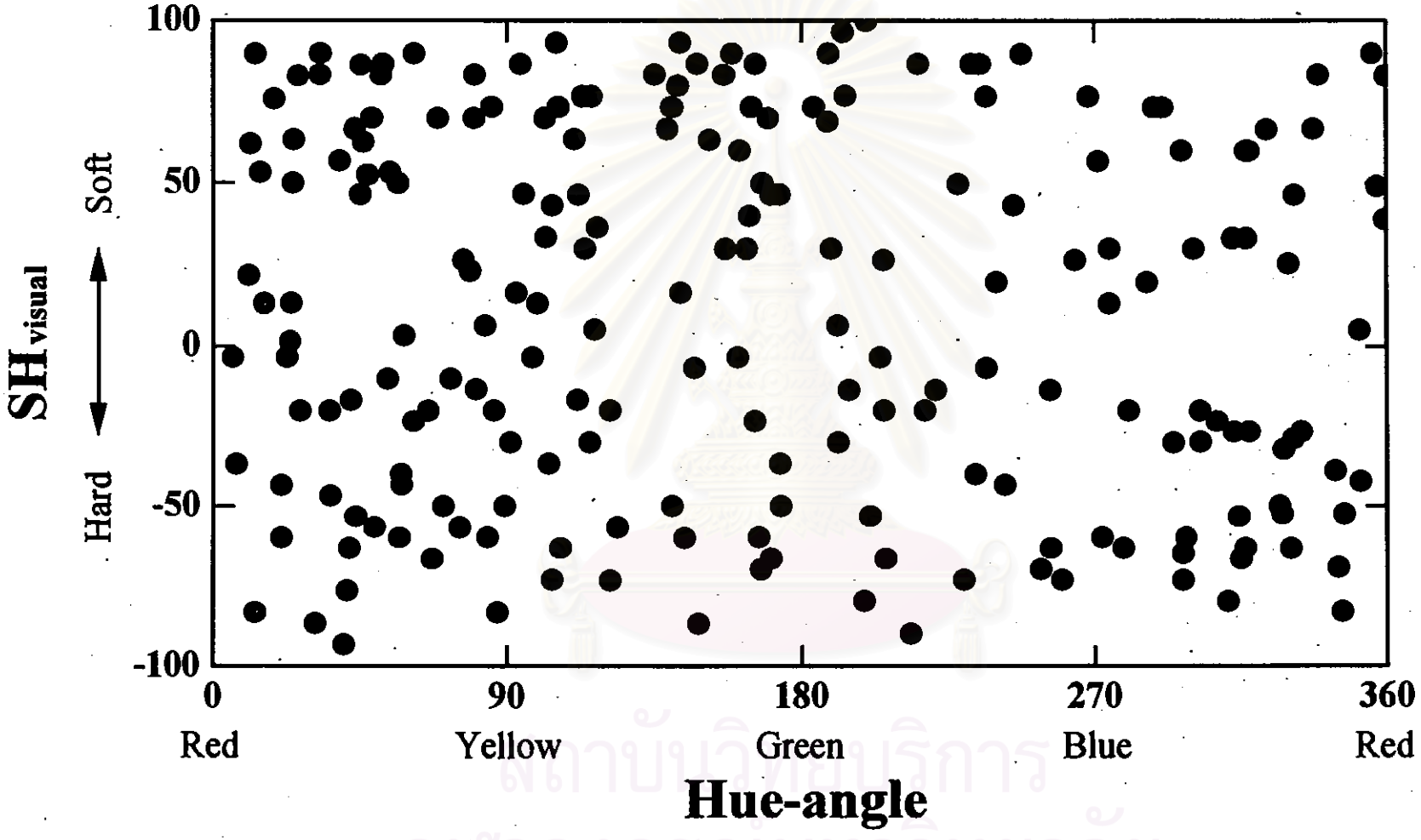


Figure 4-14 Visual results of "Soft-Hard" on Hue-angle

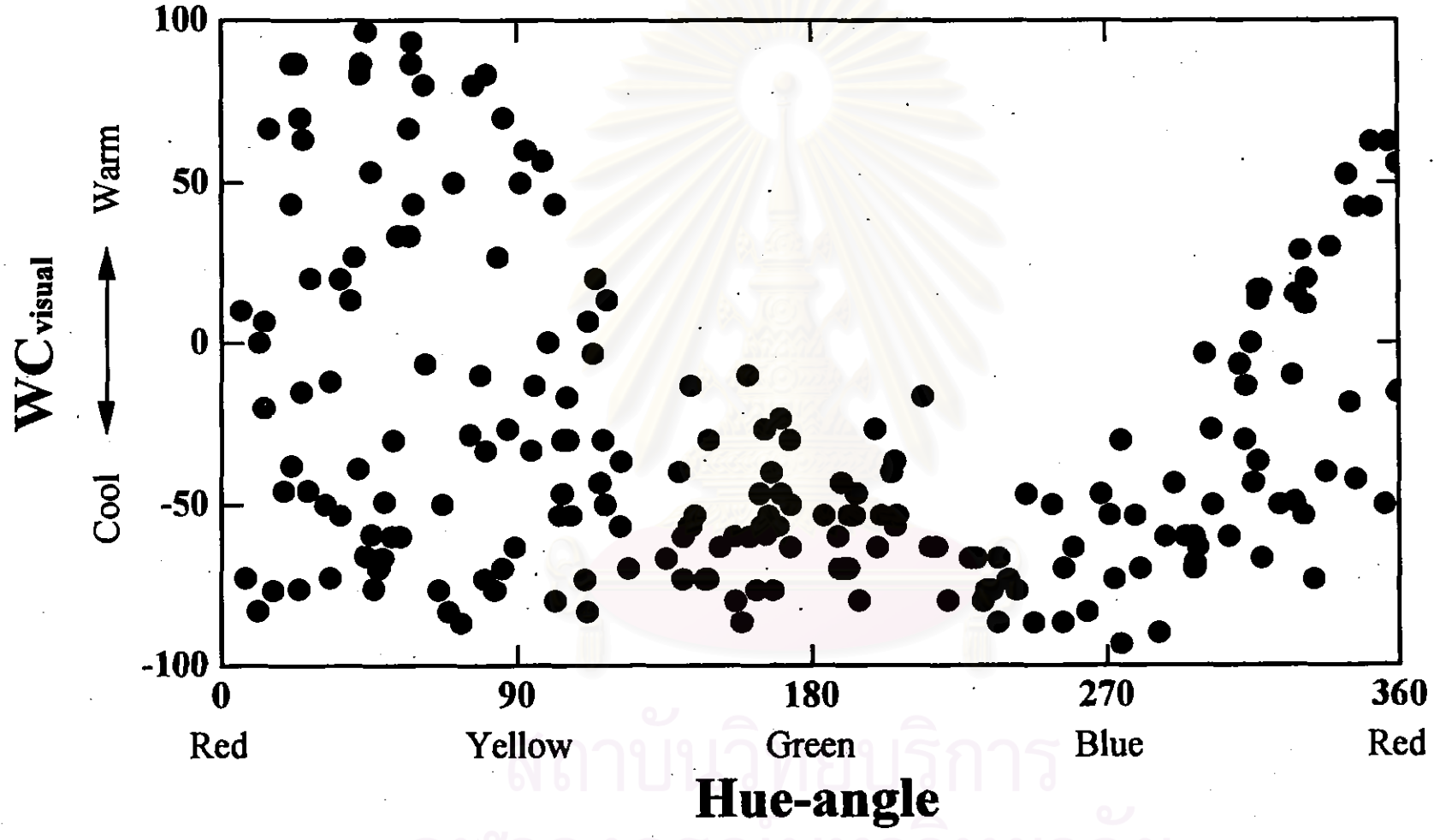


Figure 4-15 Visual results of "Warm-Cool" on Hue-angle

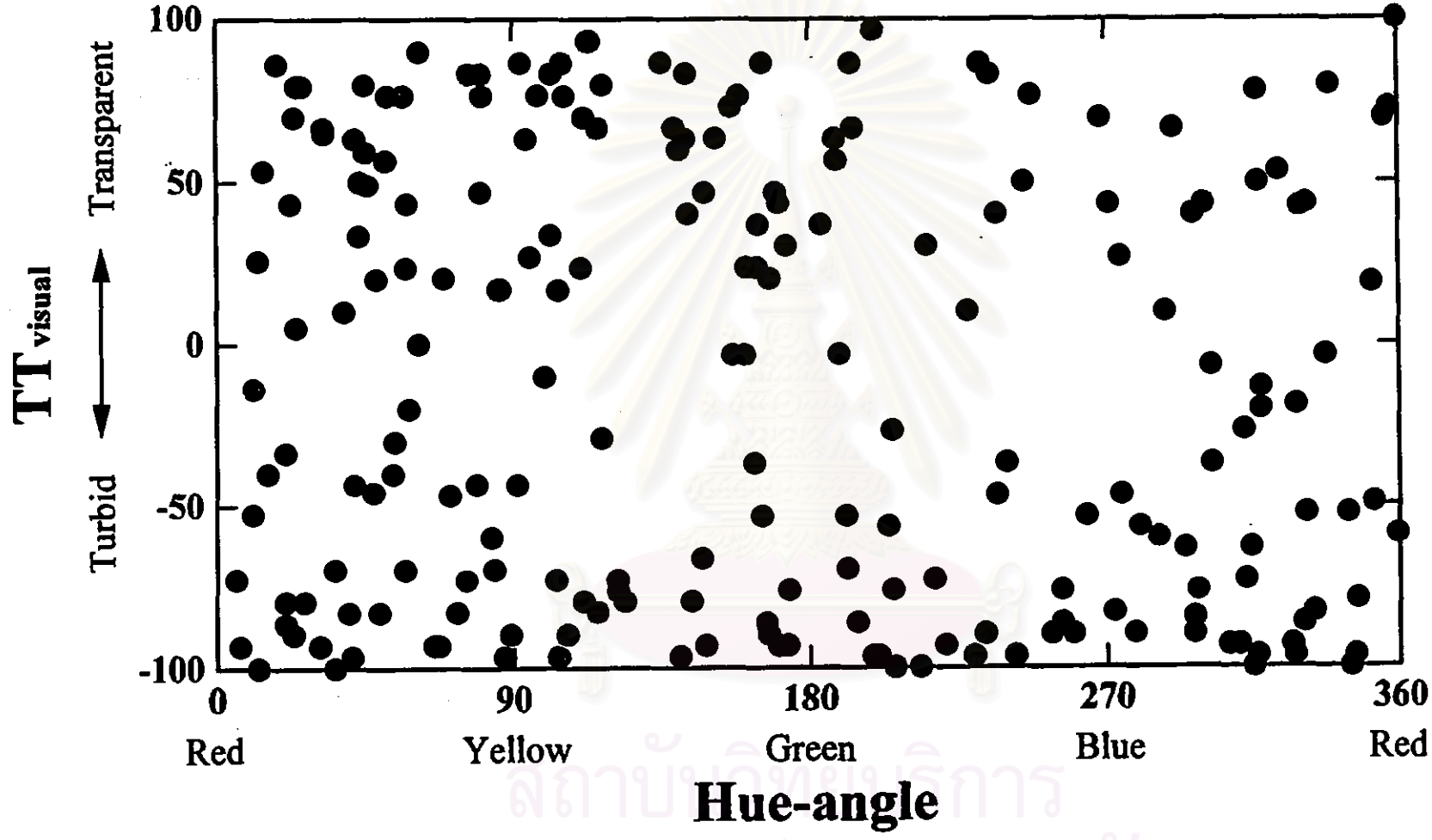


Figure 4-16 Visual results of "Transparent-Turbid" on Hue-angle

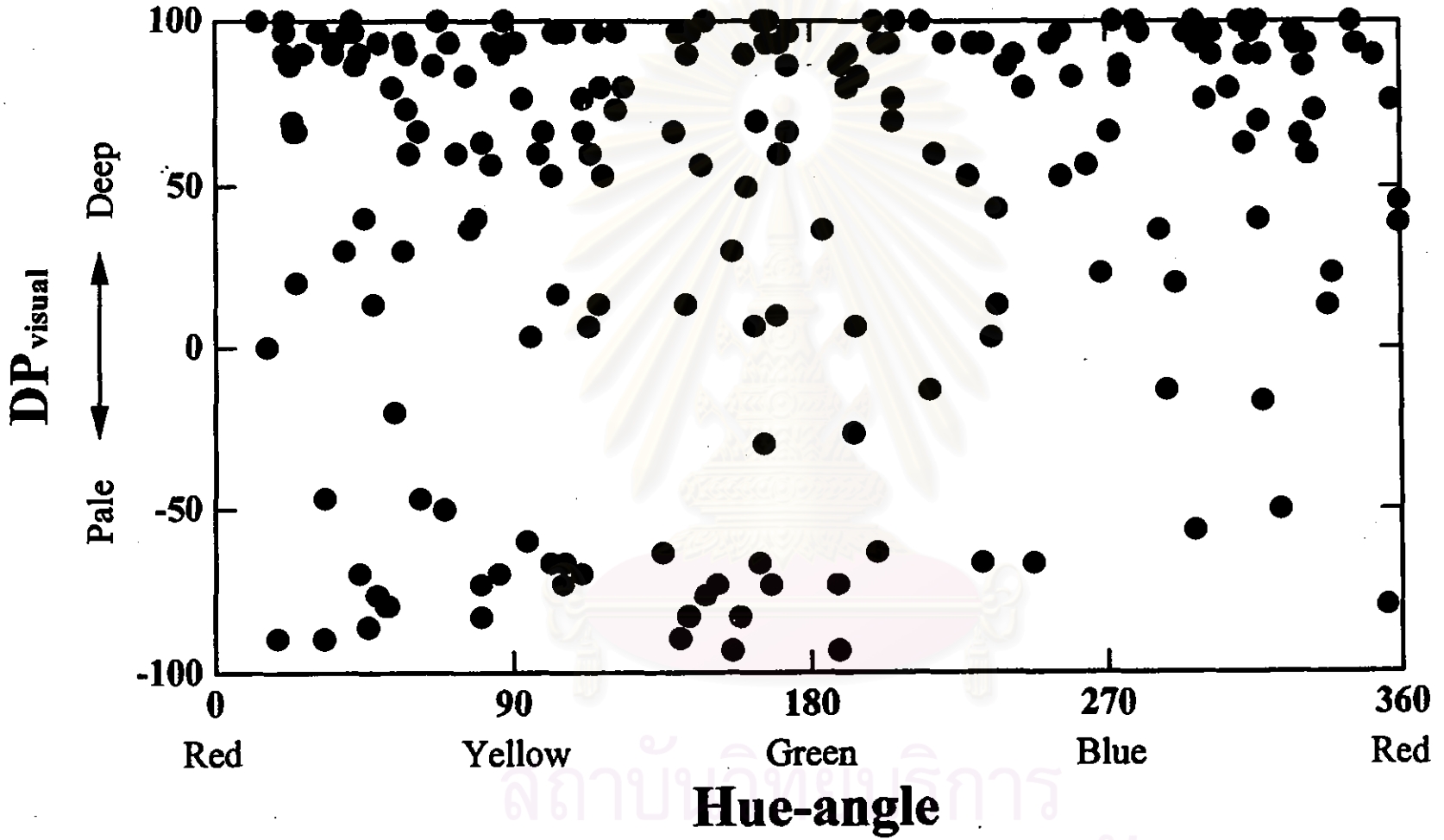


Figure 4-17 Visual results of "Deep-Pale" on Hue-angle

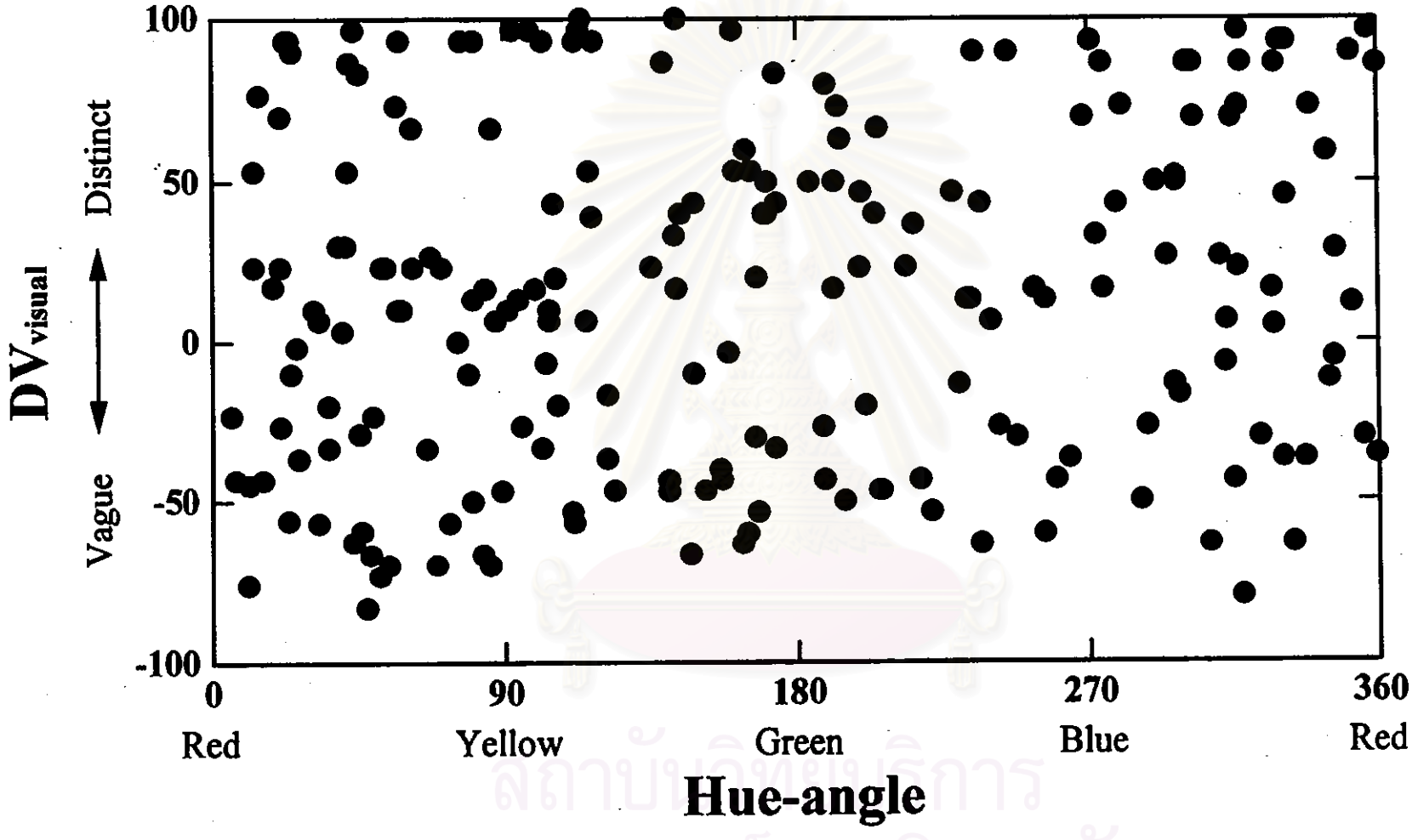


Figure 4-18 Visual results of "Distinct-Vague" on Hue-angle

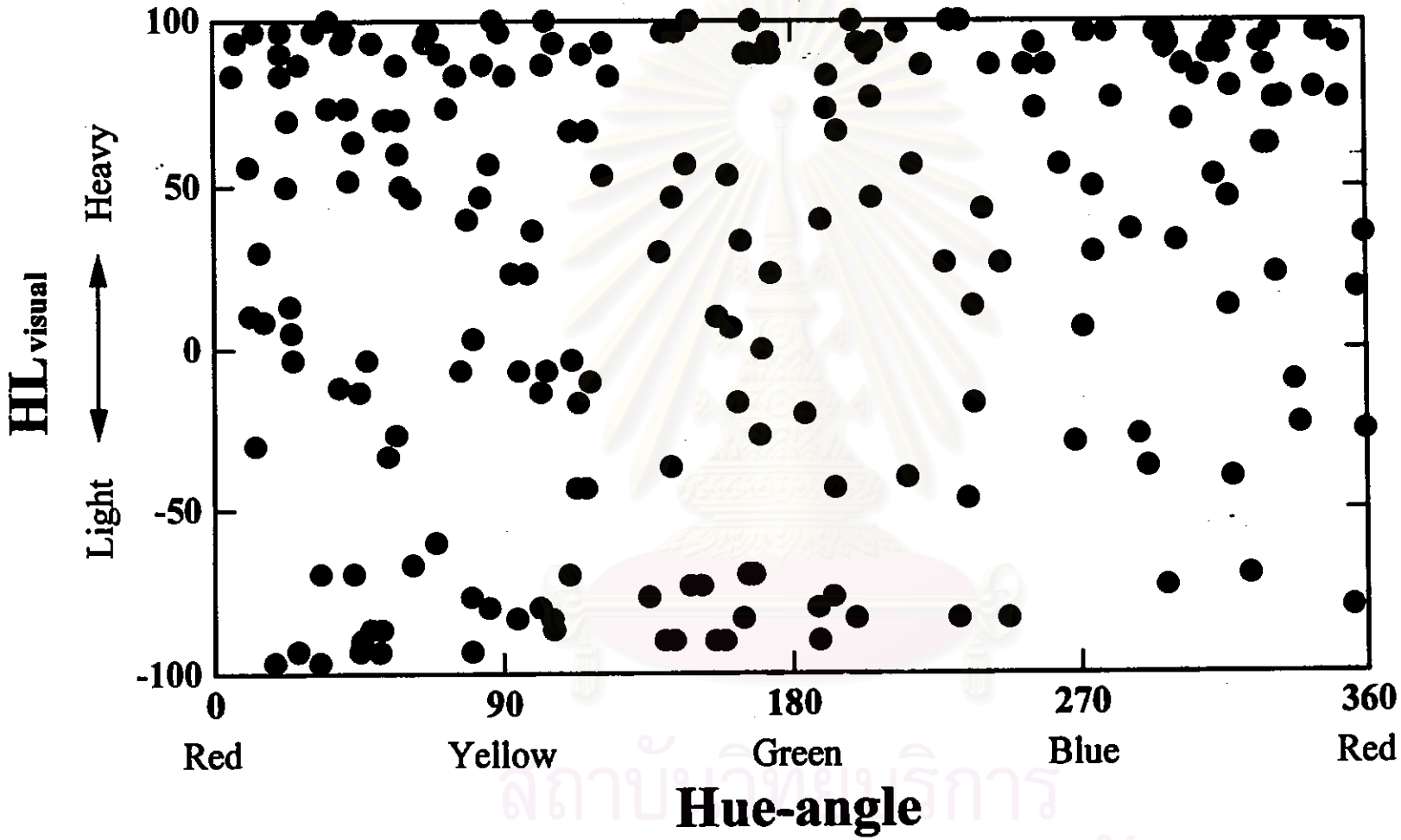


Figure 4-19 Visual results of "Heavy-Light" on Hue-angle

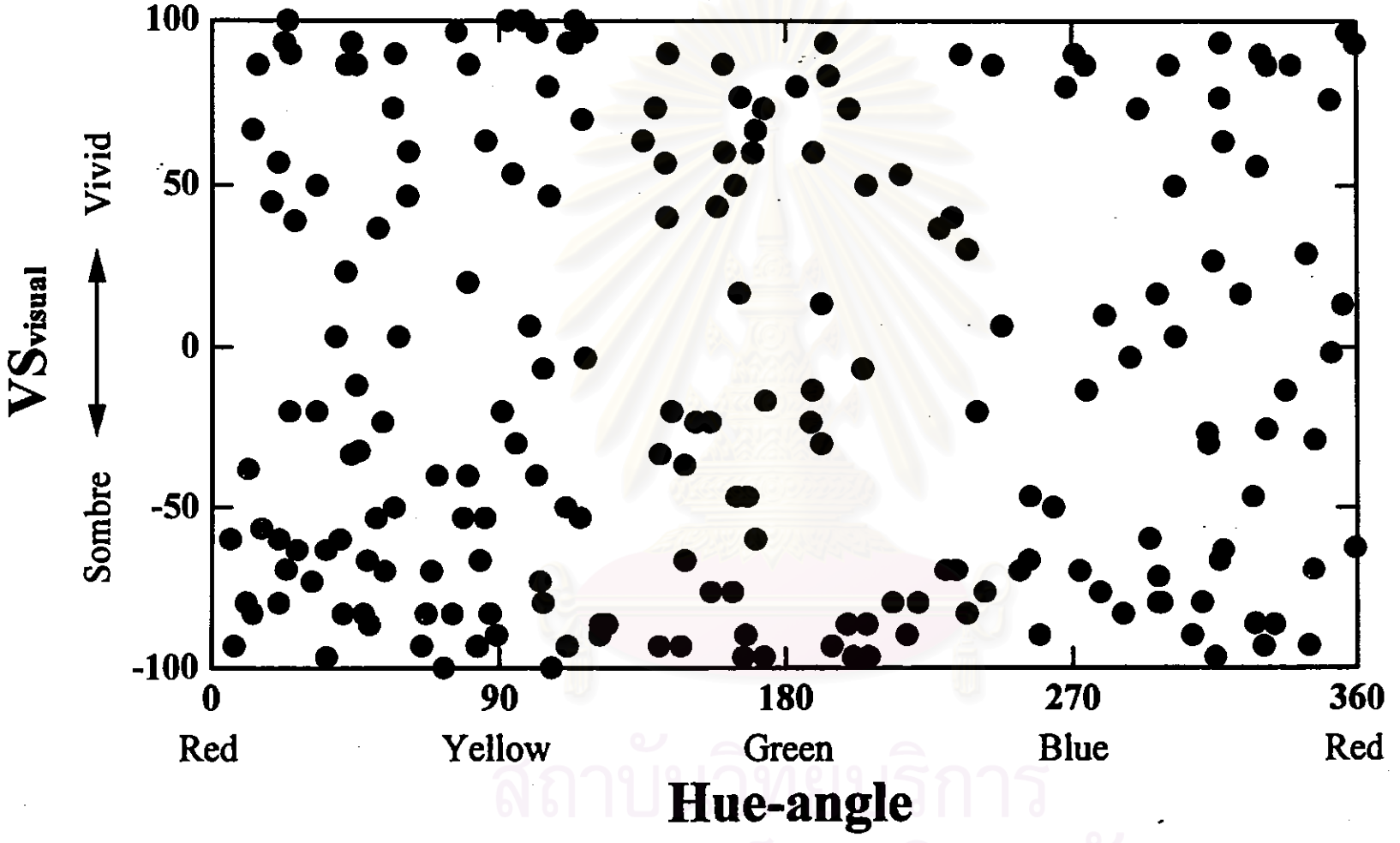


Figure 4-20 Visual results of "Vivid-Sombre" on Hue-angle

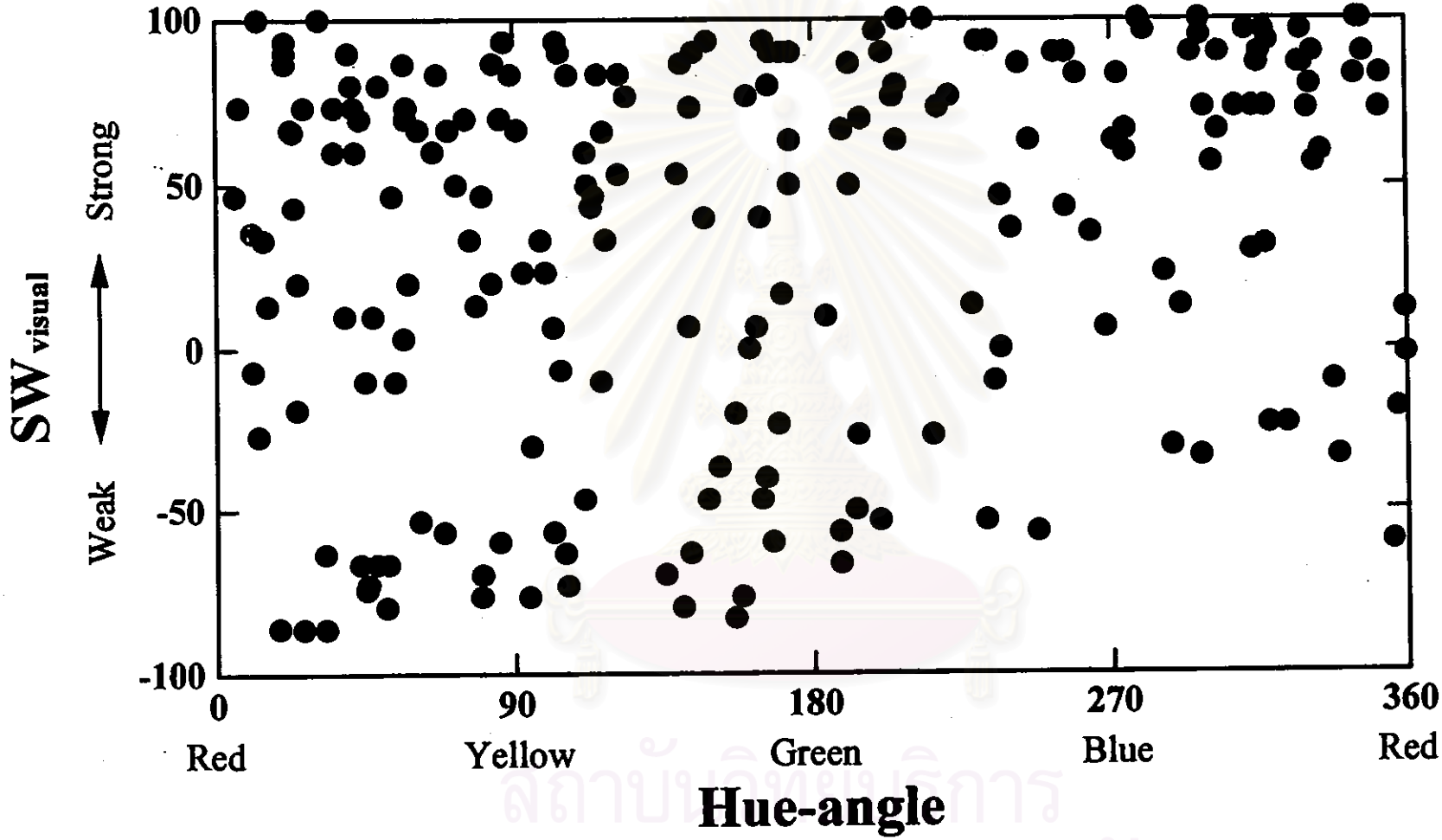


Figure 4-21 Visual results of "Strong-Weak" on Hue-angle

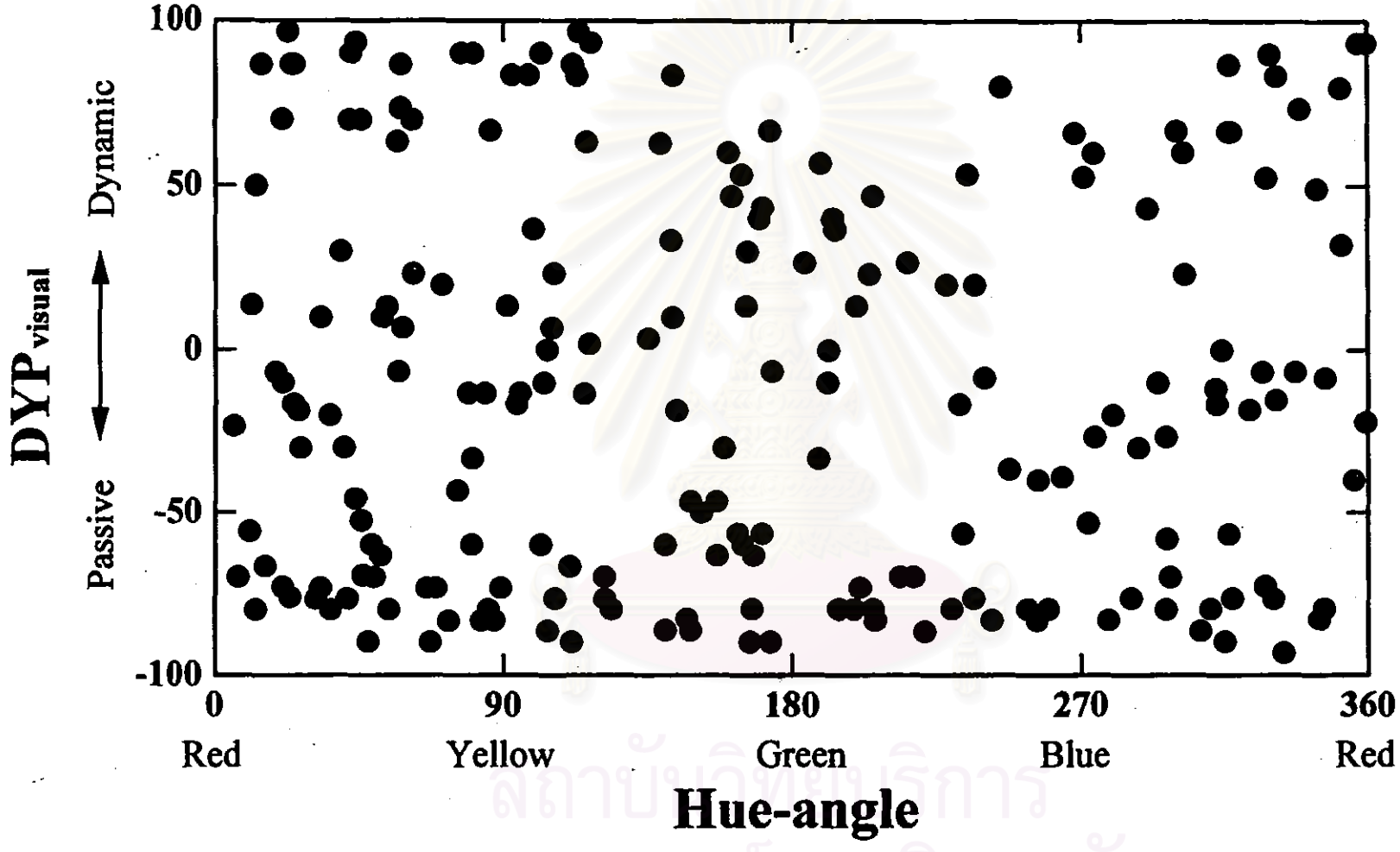


Figure 4-22 Visual results of "Dynamic-Passive" on Hue-angle

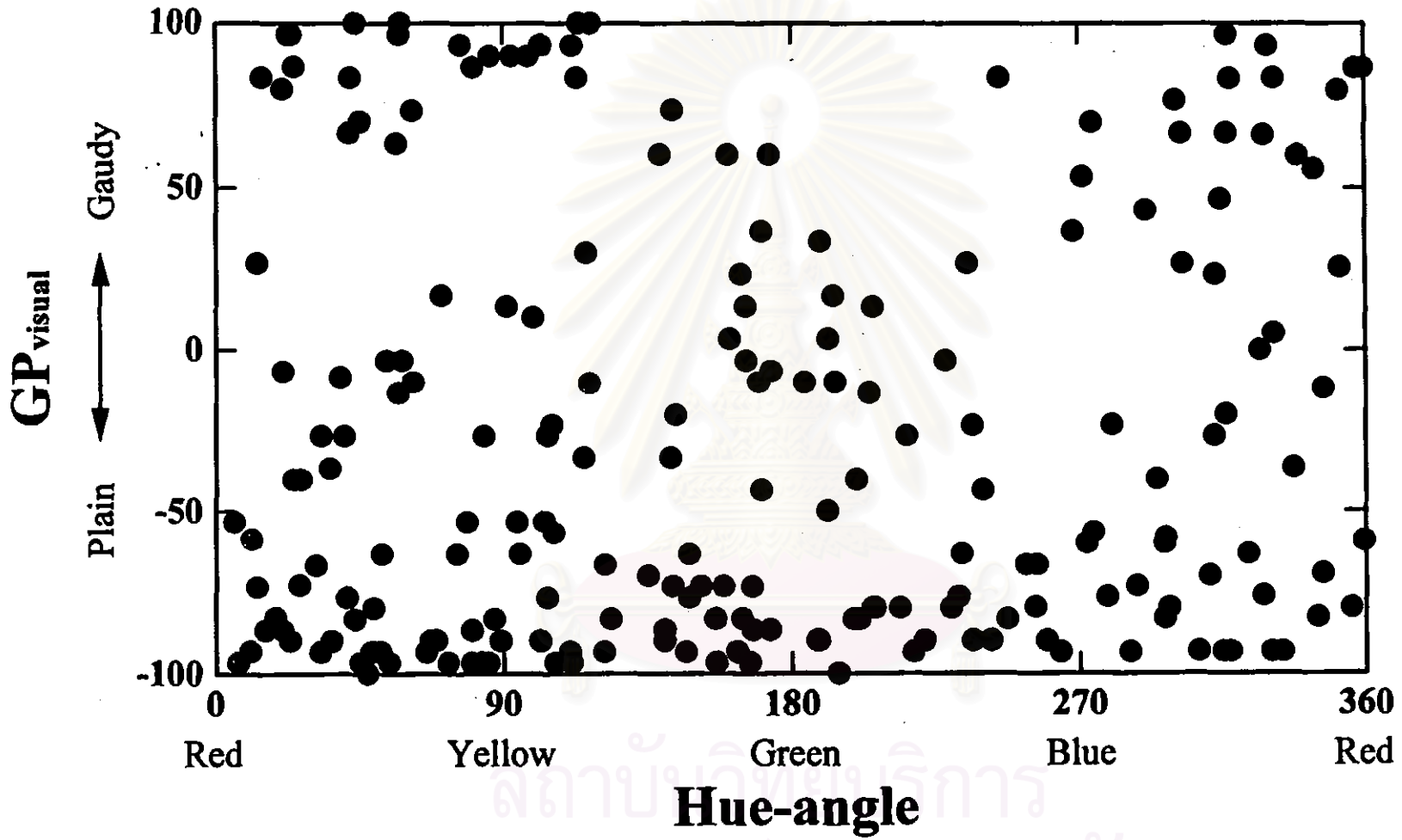


Figure 4-23 Visual results of "Gaudy-Plain" on Hue-angle

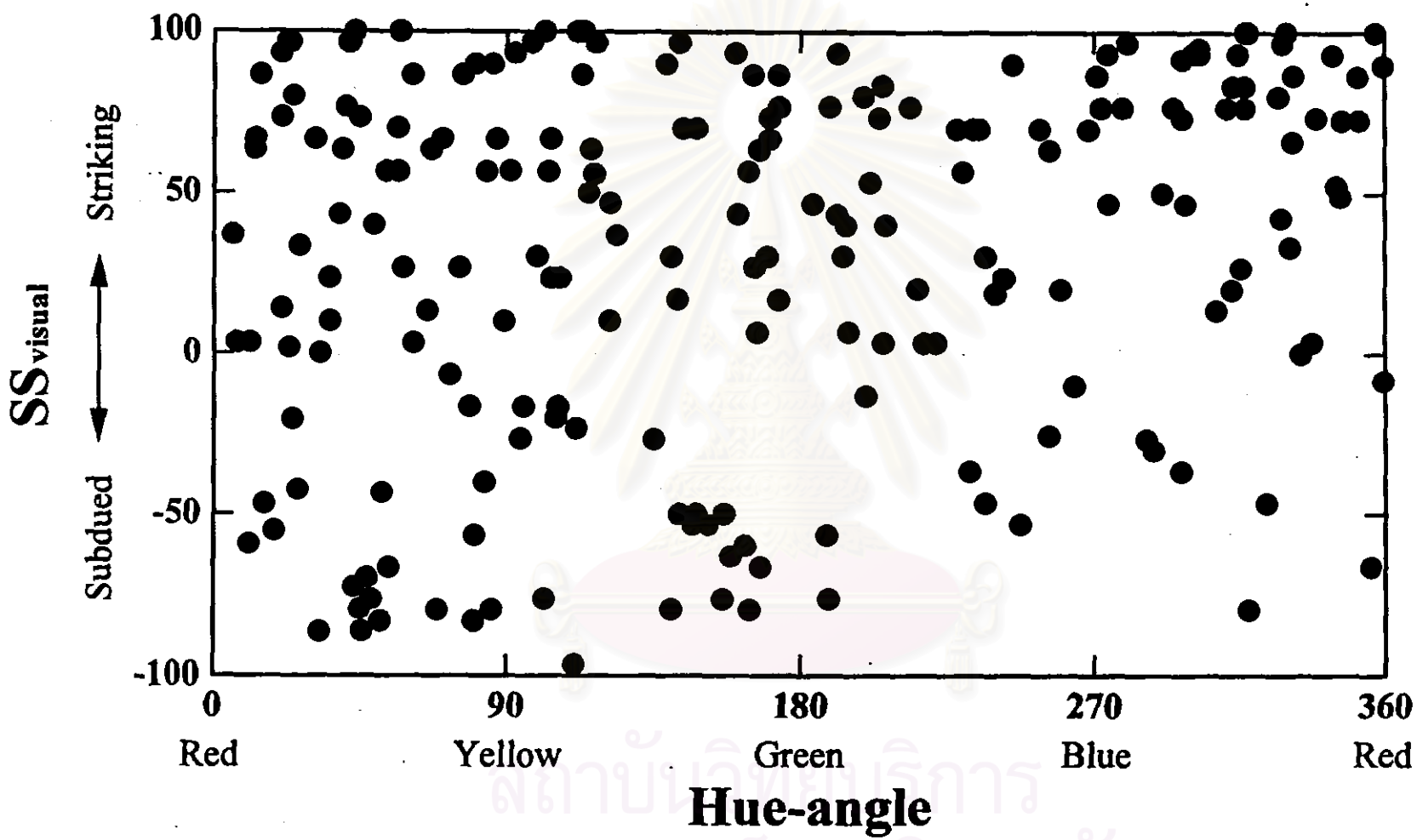


Figure 4-24 Visual results of "Striking-Subdued" on Hue-angle

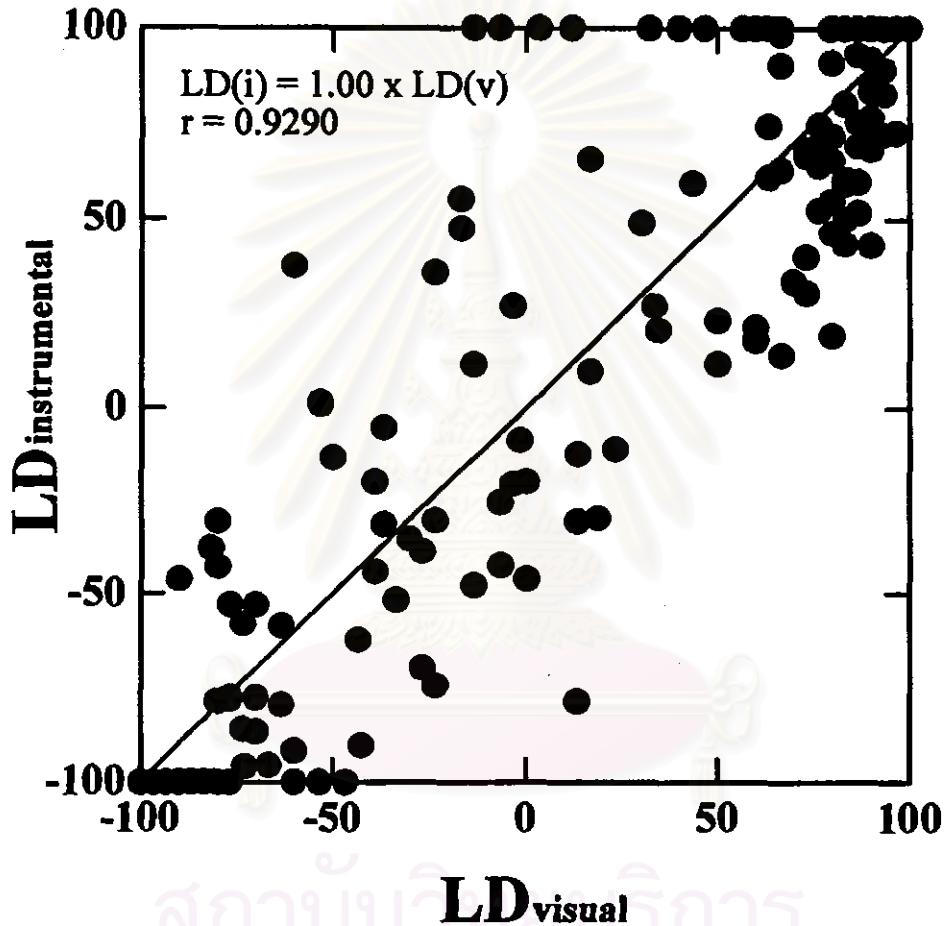


Figure 4-25 Relationship between visual results and instrumental predictions of "Light-Dark"

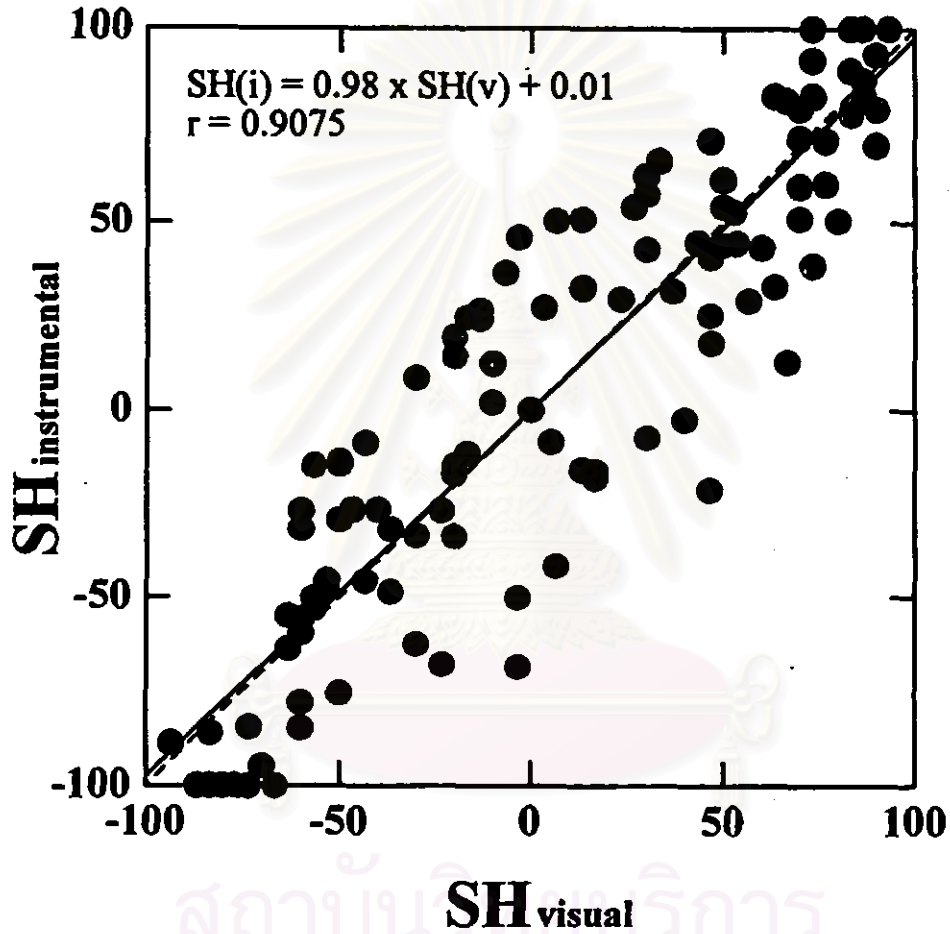


Figure 4-26 Relationship between visual results and instrumental predictions of "Soft-Hard"

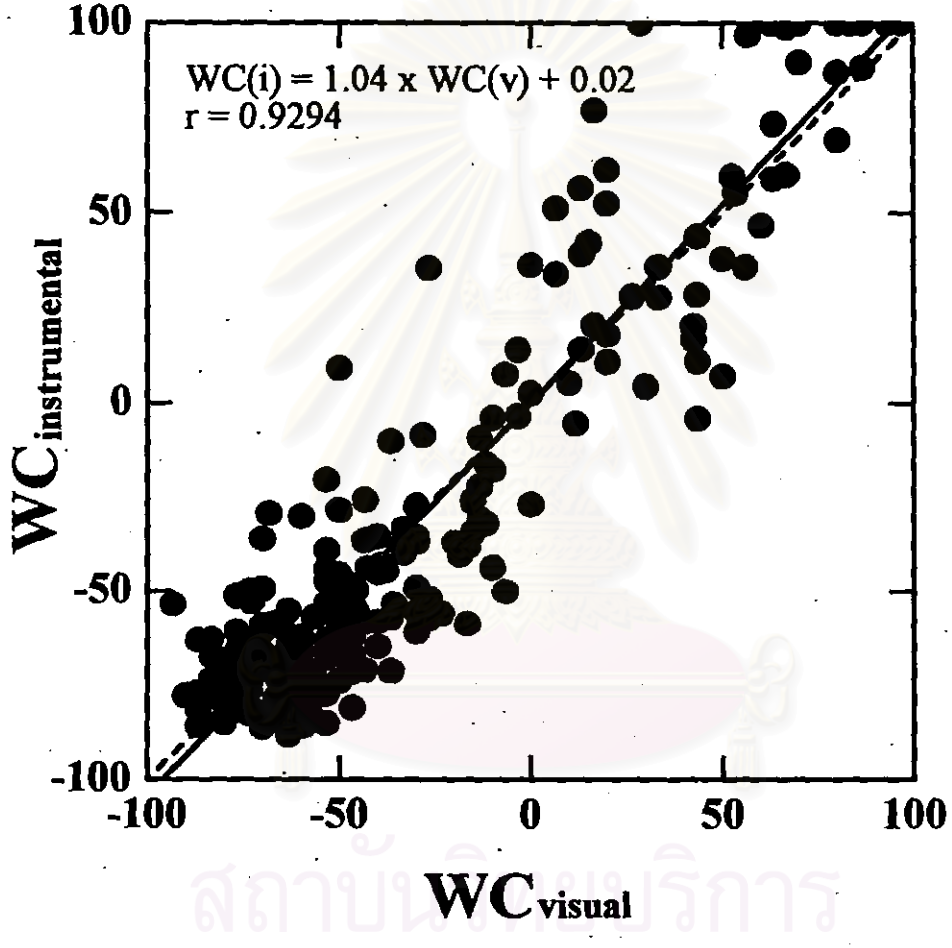


Figure 4-27 Relationship between visual results and instrumental predictions of "Warm-Cool"

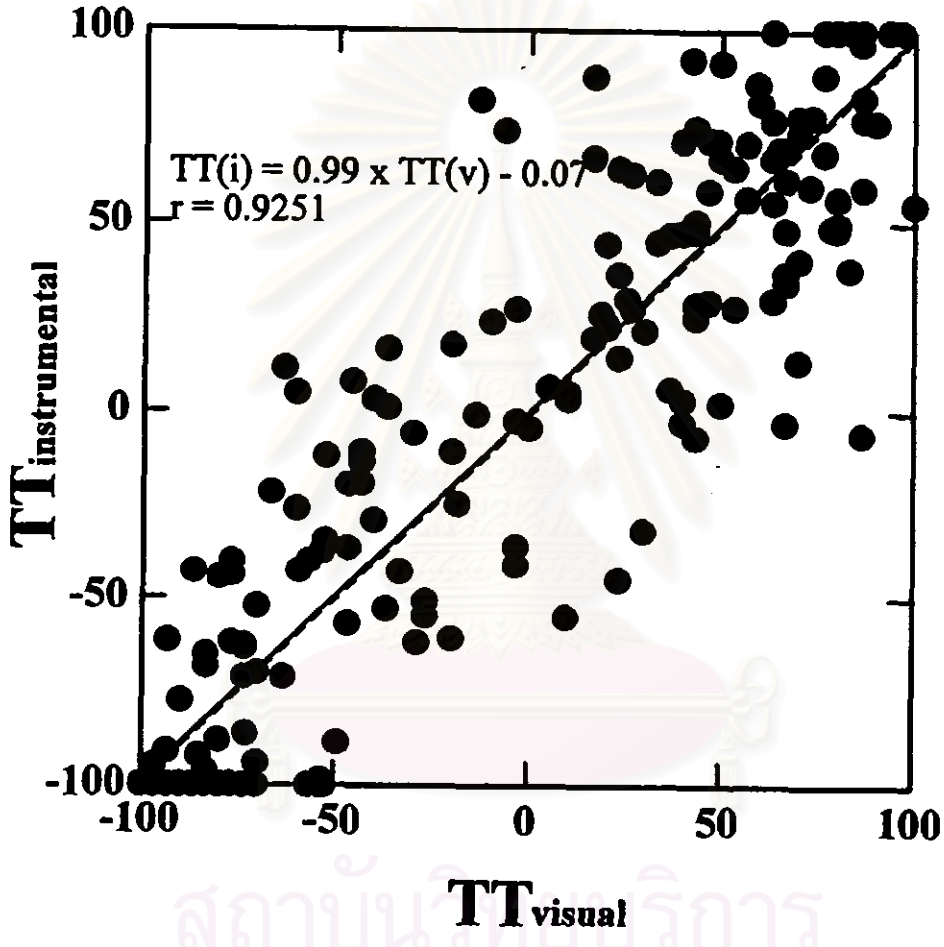


Figure 4-28 Relationship between visual results and instrumental predictions of "Transparent-Turbid"

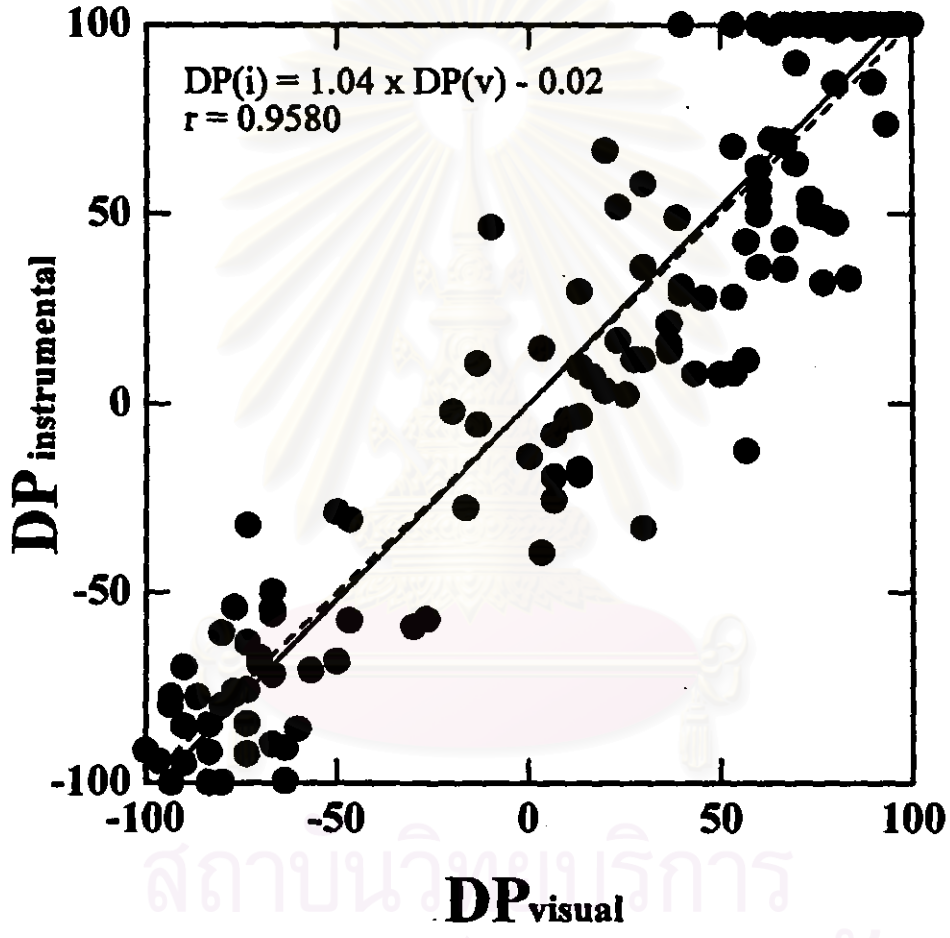


Figure 4-29 Relationship between visual results and instrumental predictions of "Deep-Pale"

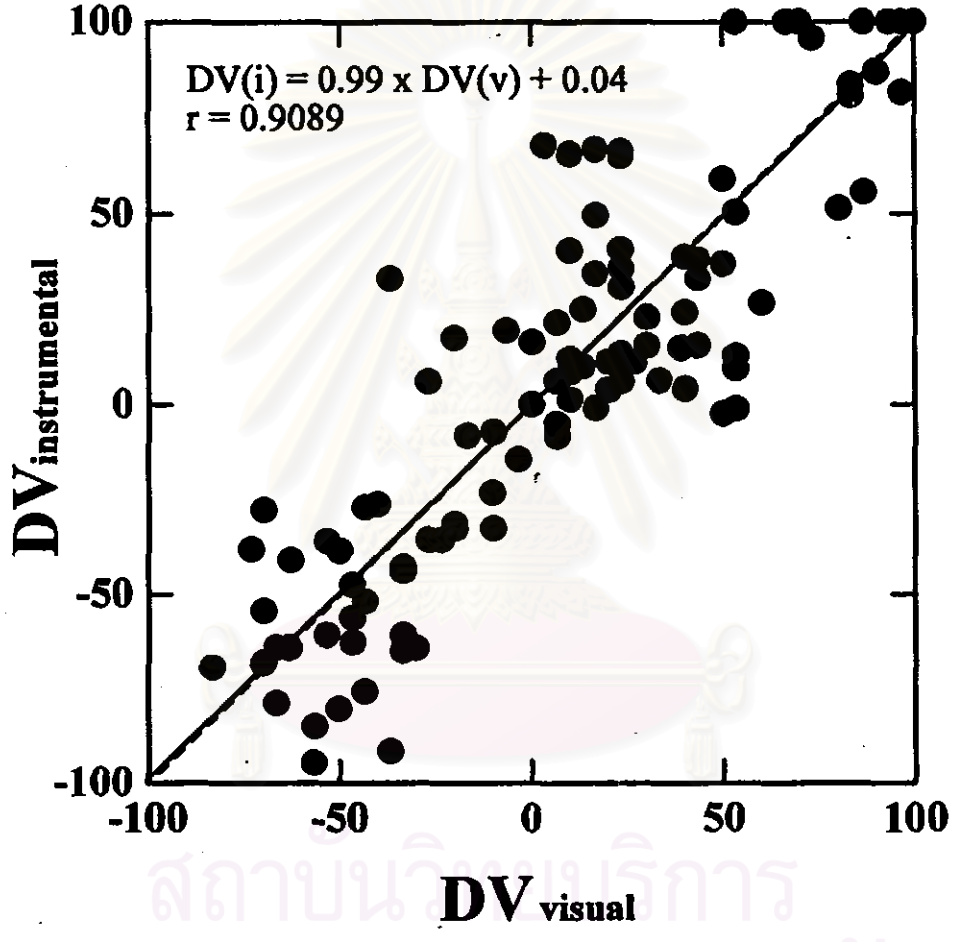


Figure 4-30 Relationship between visual results and instrumental predictions of "Distinct-Vague"

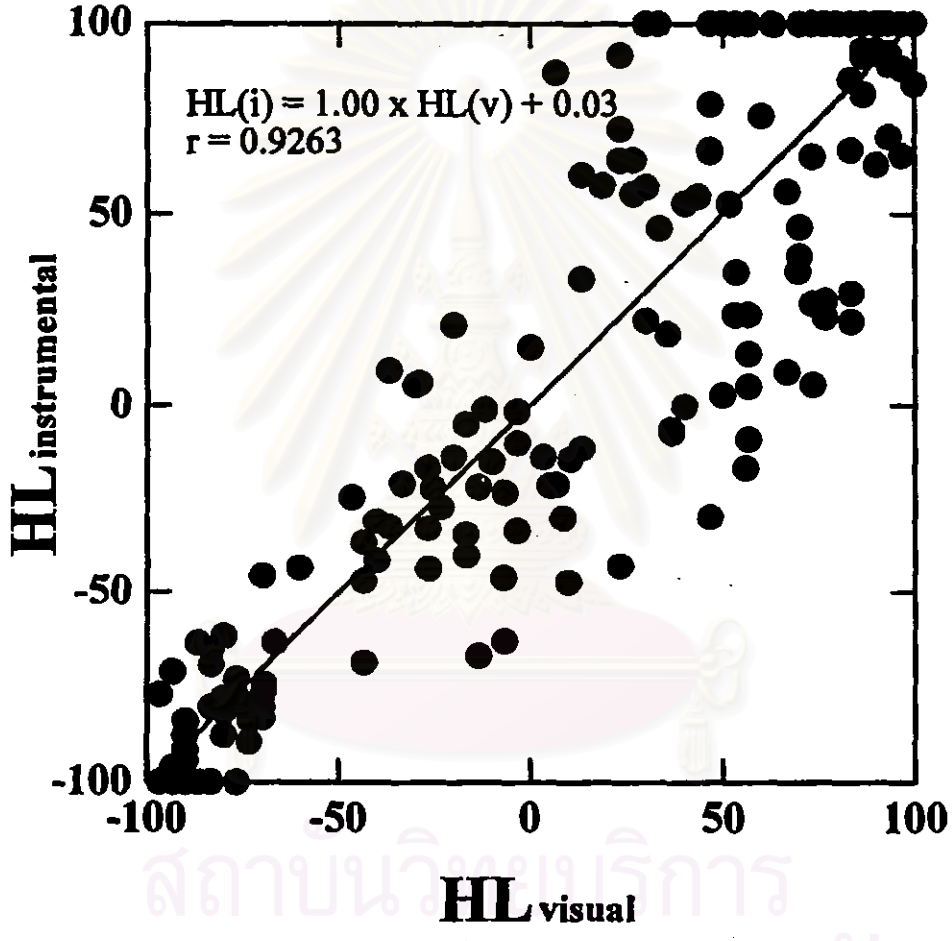


Figure 4-31 Relationship between visual results and instrumental predictions of "Heavy-Light"

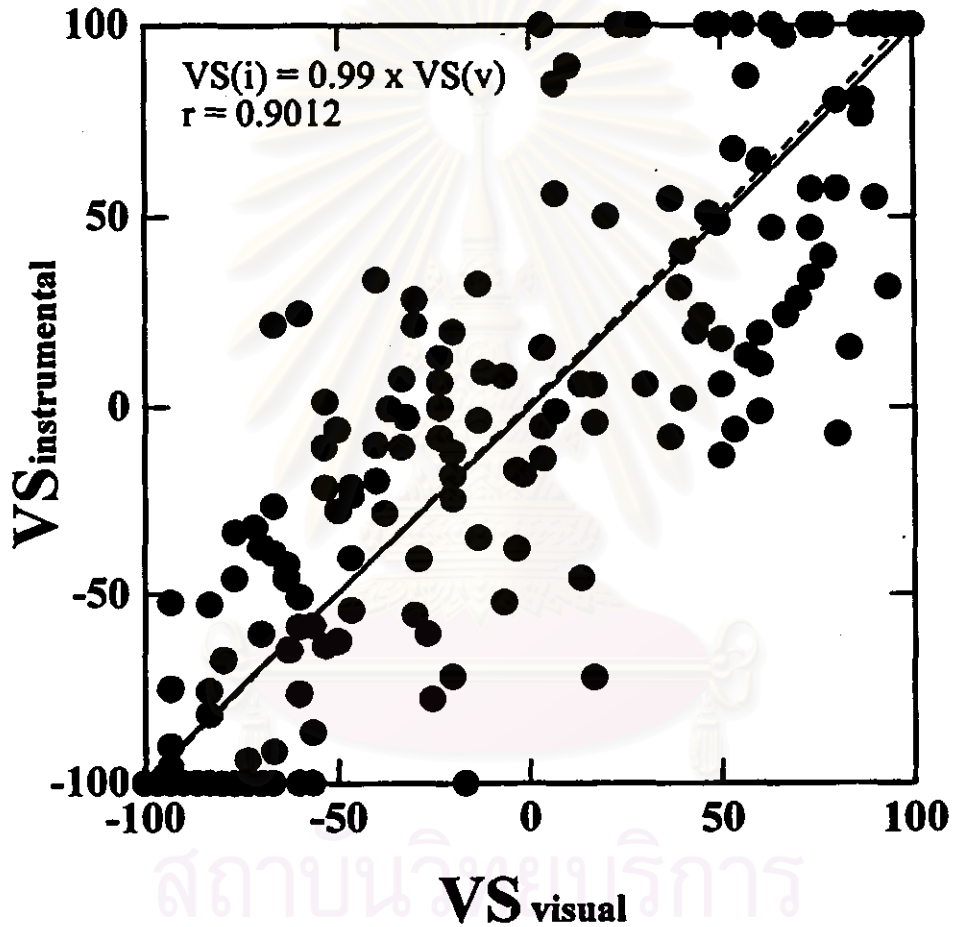


Figure 4-32 Relationship between visual results and instrumental predictions of "Vivid-Sombre"

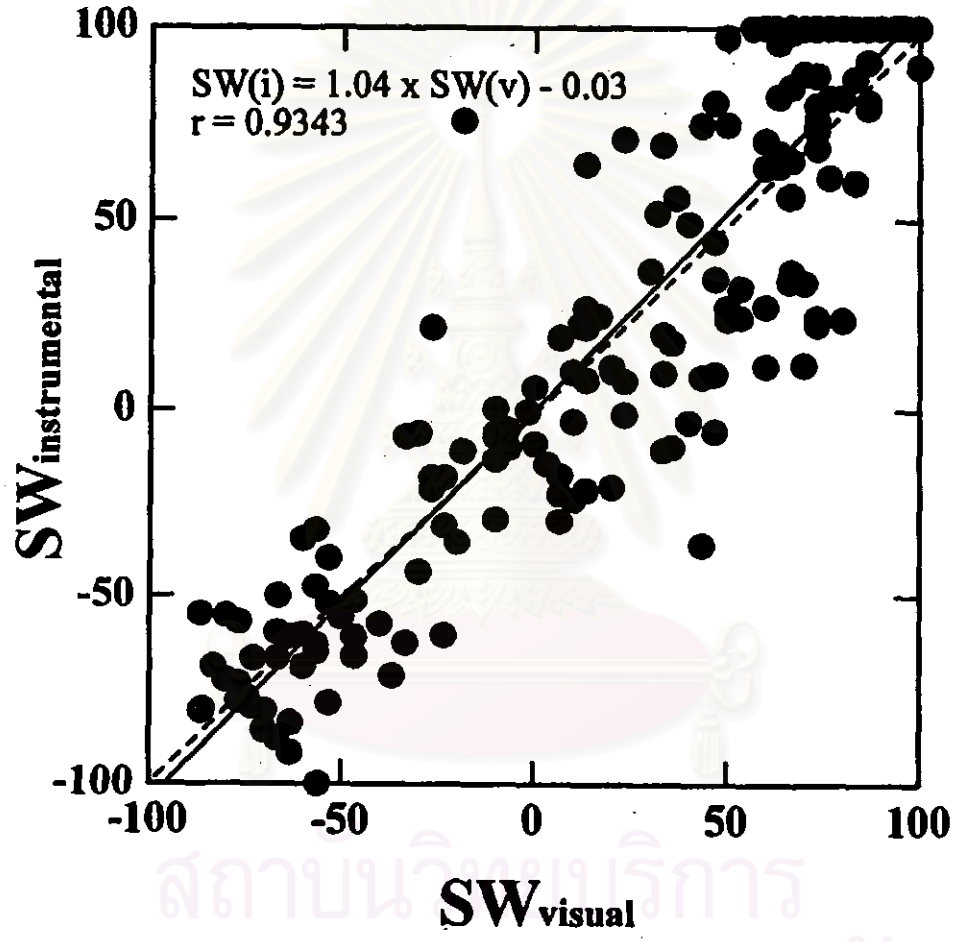


Figure 4-33 Relationship between visual results and instrumental predictions of "Strong-Weak"

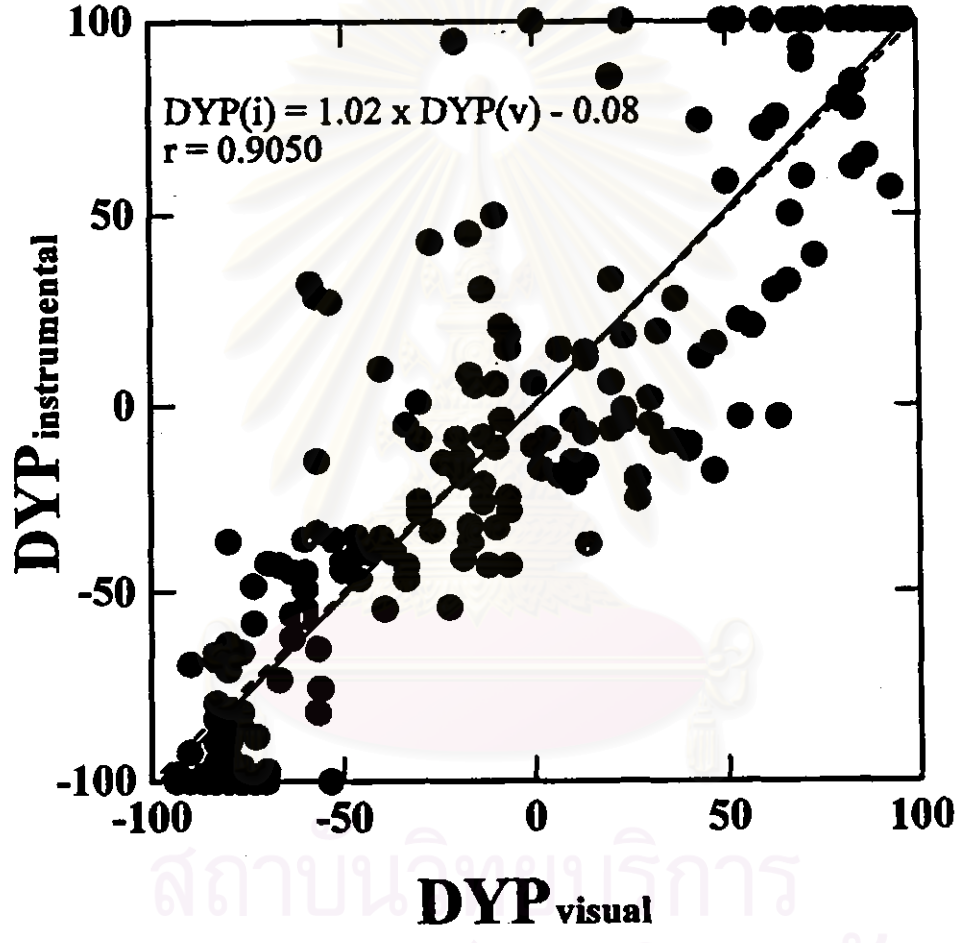


Figure 4-34 Relationship between visual results and instrumental predictions of "Dynamic-Passive"

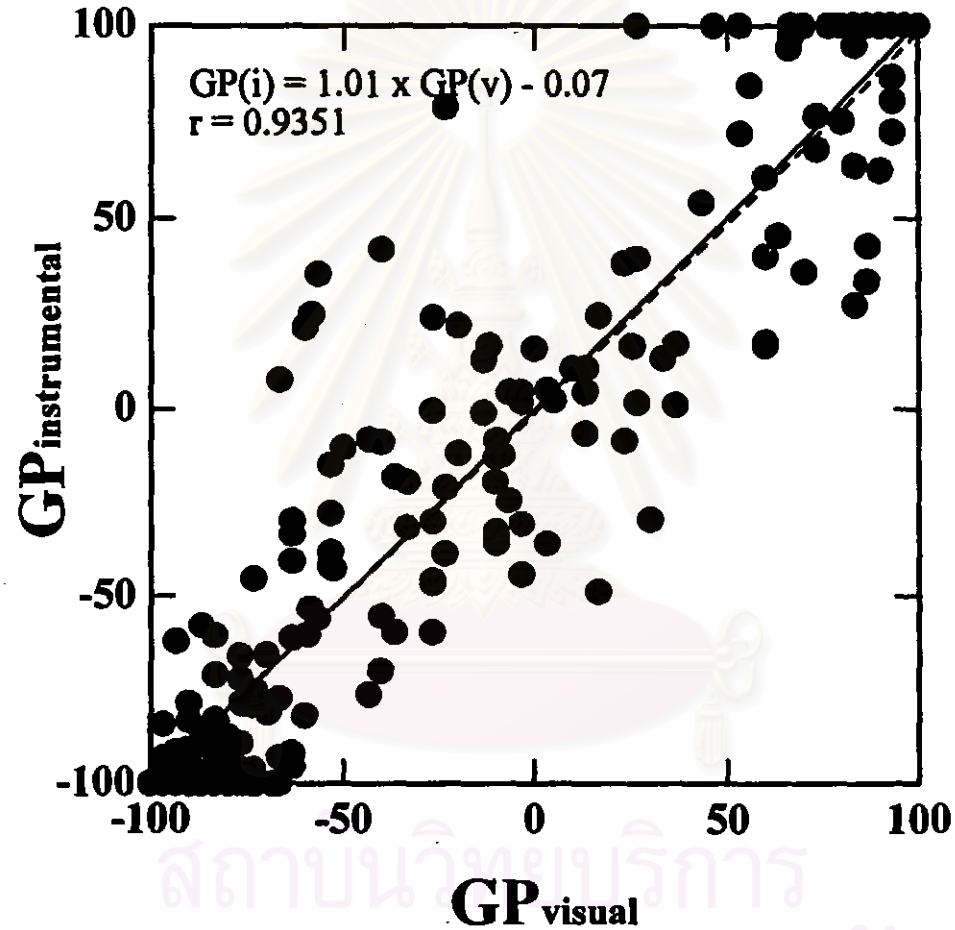


Figure 4-35 Relationship between visual results and instrumental predictions of "Gaudy-Plain"

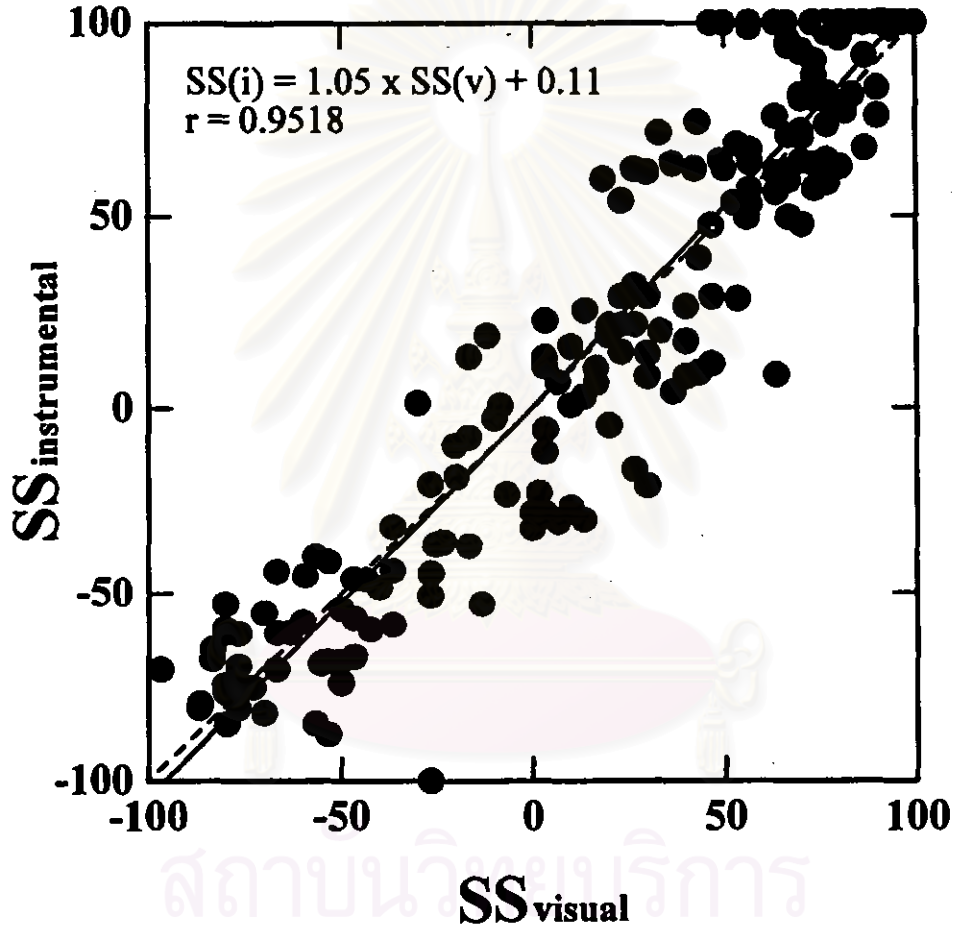


Figure 4-36 Relationship between visual results and instrumental predictions of "Striking-Subdued"

4.3 Color Perception values on CIE $L^* C^* h$ and CIE $a^* b^*$ diagrams.

The colorimetric characteristics of the color perception values are indicated by ISO-lines in CIE $L^* C^* h$ and CIE $a^* b^*$ diagrams. The projection of the color perception values are calculated from each of the empirical color perception equations. The projections of the opponent color word pairs of color perception values are shown from Figure 4-37 to Figure 4-60. The summarise is as follows:

(a) ISO-LD lines are drawn from the results that all observers assess color as "Light" at the h=270 when chroma > 40 and at the h=90 when chroma > 70. Low chroma and low lightness are assessed as "Dark". The results show in Figure 4-38 support those in Figure 4-37; "Dark" locates in the middle zone of color. In addition, hue has a small contribution to "Light-Dark" color perception values on L^* plane.

(b) ISO-SH lines in Figure 4-39 comes from the results that all observers assess color as "Soft" at the lightness > 90 and "Hard" when lightness < 30. For Figure 4-40, color in the middle of color space which grey area, 75% of observers assess color as "Hard" and 25% of observers assess color as "Soft". There are a little hue contribution to "Soft-Hard" color perception values on L^* plane.

(c) ISO-WC lines in Figure 4-41 show that all observers assess color in high chroma areas as "Warm". Figure 4-42 shows that "Warm-Cool" color perception has hue contribution.

(d) For ISO-TT lines in Figure 4-43, all observers assess color in high chroma and high lightness areas as "Transparent" and assess color near and in dark

grey area as "Turbid". Figure 4-44 shows that grey with the low chroma in the middle of color space is assessed as "Turbid". There is a small hue contribution to "Transparent-Turbid" color perception values on L^* plane.

(e) ISO-DP lines in Figure 4-45, all observers assess color as "Pale" at the lightness > 85 and assess color as "Deep" when lightness < 50. In Figure 4-40, more than 75% of observers assess grey area in the middle of color space as "Deep".

(f) ISO-DV lines in Figure 4-47, all observers assess color as "Distinct" at the h=270 when chroma > 30 and at the h=90 when chroma > 65. Low chroma color near the center of color space are assessed as "Vague". For Figure 4-48, the diagram corresponds to Figure 4-47. Color in the middle of color space which grey area in the low chroma are assessed as "Vague". There are a little hue contribution to "Distinct-Vague" color perception values on L^* plane.

(g) ISO-HL lines in Figure 4-49 , all observers assess color as "Light" at lightness > 85 and assess color as "Heavy" when lightness < 45. In Figure 4-50, more than 75% of observers assess grey in the middle of color space which grey area, as "Heavy".

(h) For ISO-VS lines in Figure 4-51, all observers assess color as "Vivid" at the h=270 when chroma > 45 and at the h=90 when chroma > 70. Low chroma and low lightness are assessed as "Sombre". The diagram in Figure 4-52 corresponds that of Figure 4-51; grey with low chroma in the middle of color space is assessed as "Sombre". There is a small hue contribution to "Vivid-Sombre" color perception values on L^* plane.

(i) ISO-SW in Figure 4-53 shows that all observers assess color as "Weak" at lightness > 90 and assess color as "Strong" when lightness < 40. In Figure 4-54, more than 75% of observers assess grey in the middle of color space as "Strong".

(j) ISO-DYP lines in Figure 4-55, all observers assess color as "Dynamic" at the h=270 when chroma > 35 and at the h=90 when chroma > 70. Area of low chroma near the center of color space is assessed as "Passive". The diagram in Figure 4-56 corresponds to that of Figure 4-55. Area of grey with low chroma in the middle of color space is assessed as "Passive". There is a small hue contribution for "Dynamic-Passive" color perception values on L^* plane.

(k) ISO-GP lines in Figure 4-57 shows that all observers assess color as "Gaudy" at the h=270 when chroma > 45 and at the h=90 when chroma > 70. Low chroma color are assessed as "Plain". For Figure 4-58, the diagram corresponds to Figure 4-57. Color in the middle of color space which grey area in the low chroma are assessed as "Plain". There is a little hue contribution to "Gaudy-Plain" color perception values on L^* plane.

(l) ISO-SS lines in Figure 4-59 shows that all observers assess color as "Strinking" at the h=270 when chroma > 35 and at the h=90 when chroma > 55. Low chroma and high lightness area is assessed as "Subdued". The diagram in Figure 4-60 corresponds to that in Figure 4-59. Half of observers assess the area of grey with low chroma in the middle of color space as "Striking" and the other half assess this area as "Subdued". There is a small hue contribution to "Striking-Subdued" color perception values on L^* plane.

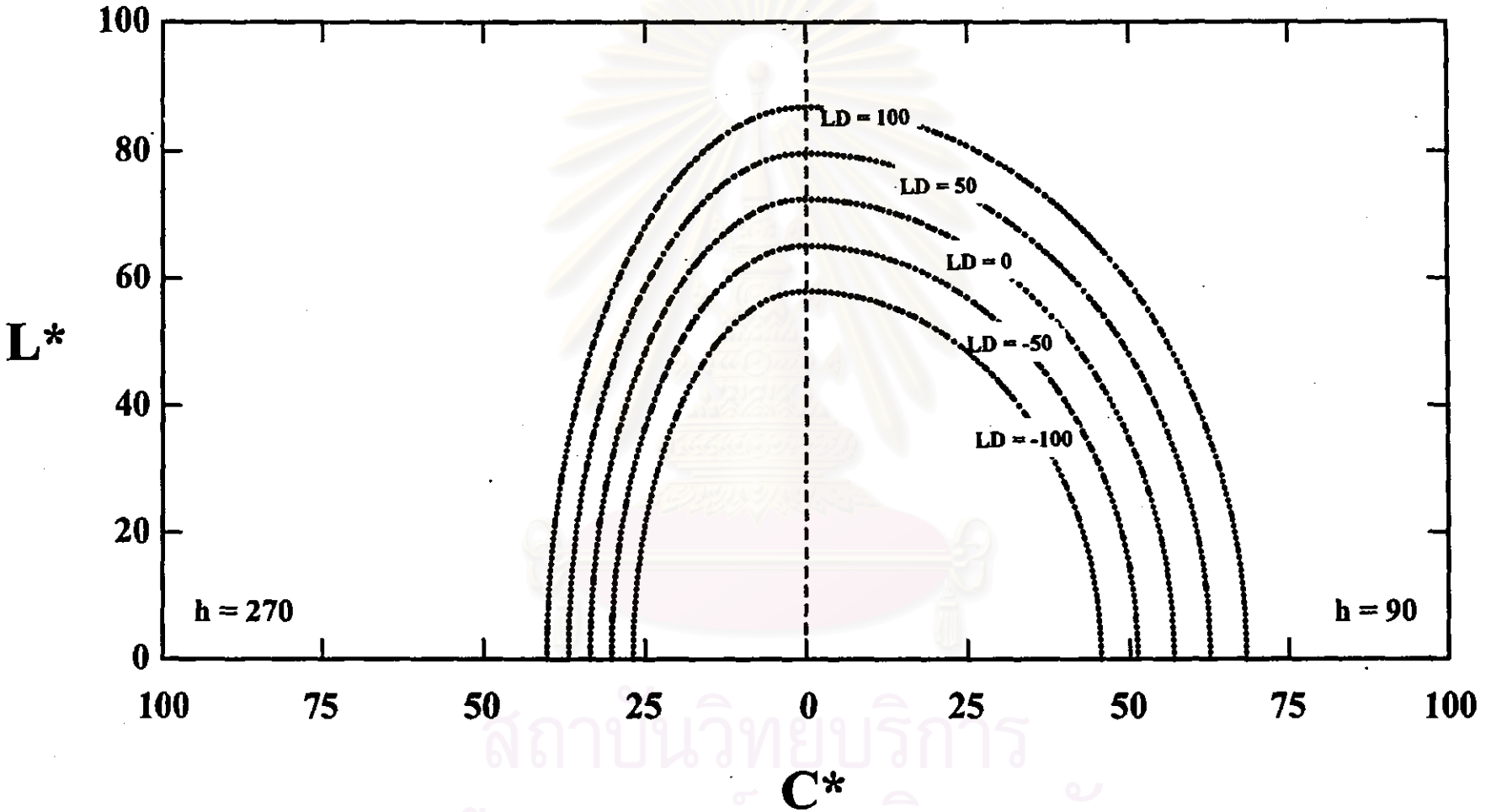


Figure 4-37 ISO-LD lines on CIE L* C* (h= 90 and h=270) plane

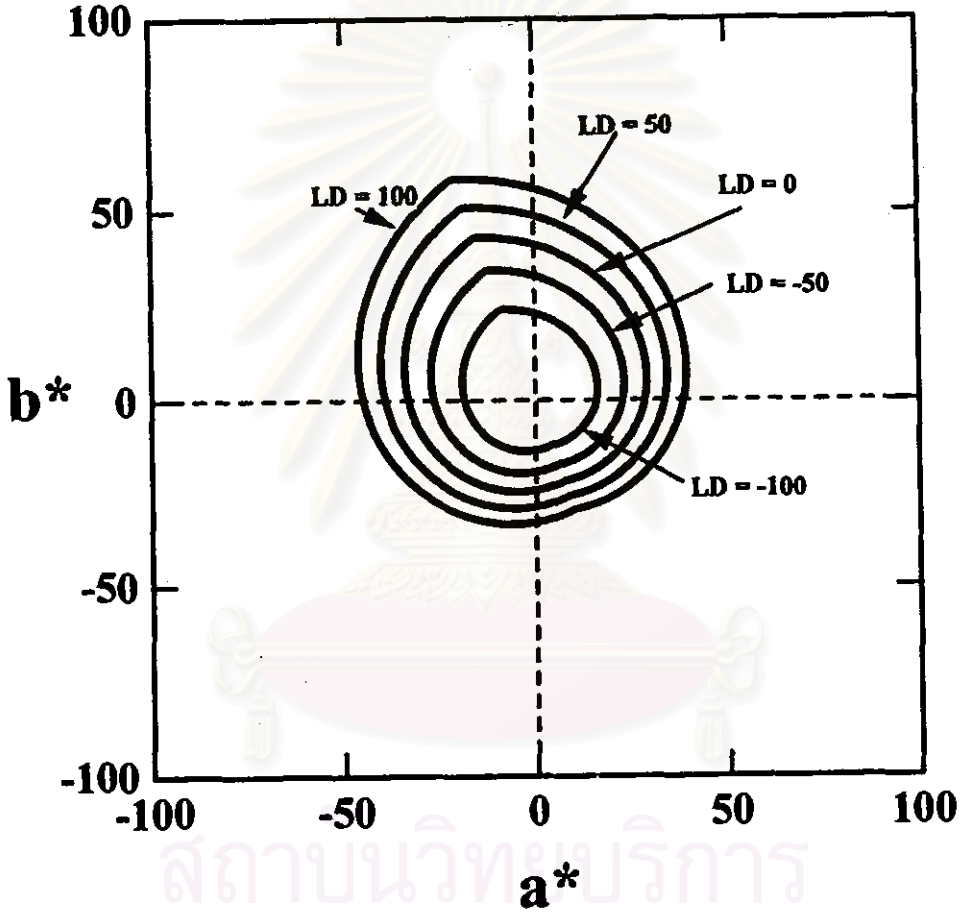


Figure 4-38 ISO-LD lines on CIE a* b* (L* = 50) plane

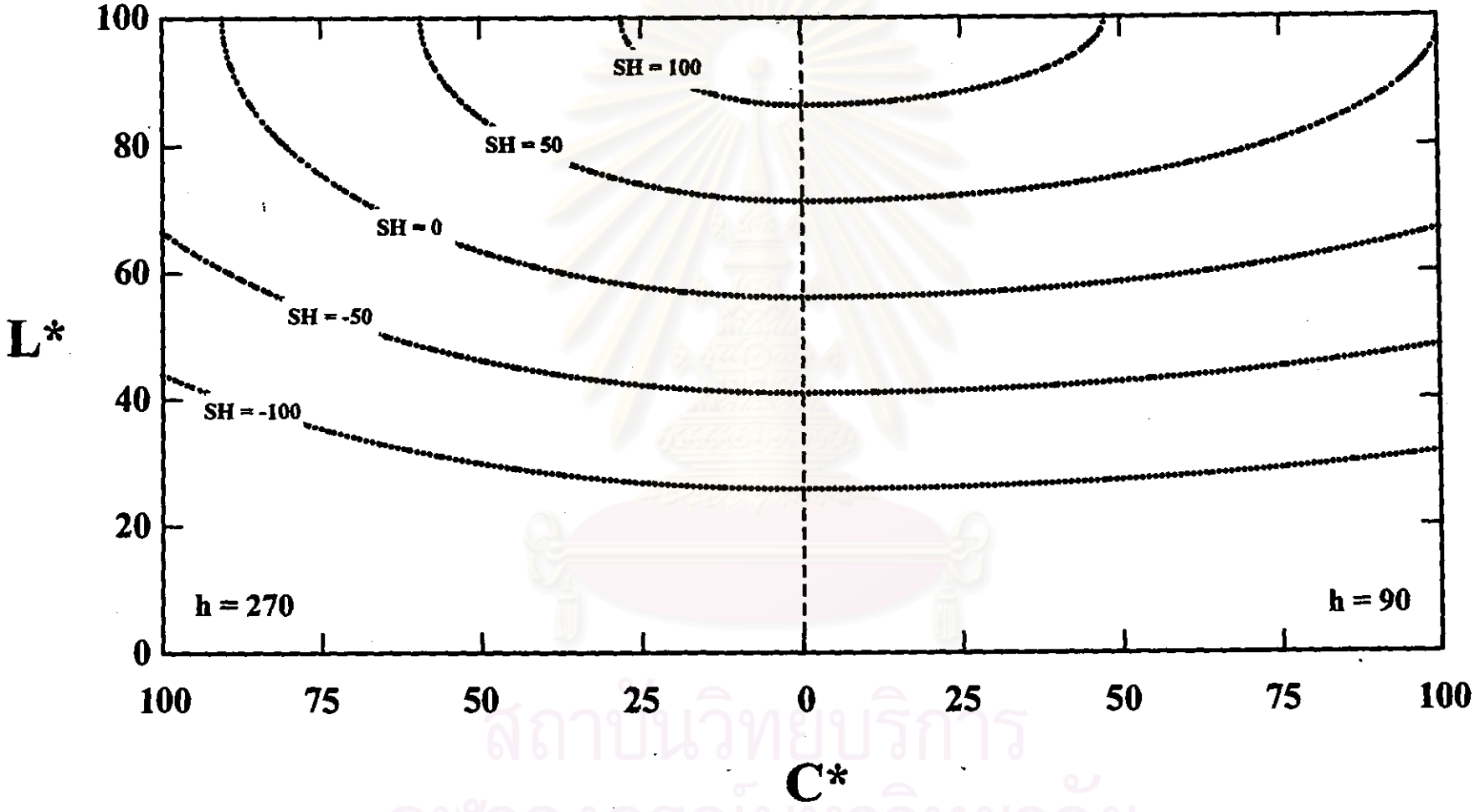


Figure 4-39 ISO-SH lines on CIE L* C* (h= 90 and h=270) plane

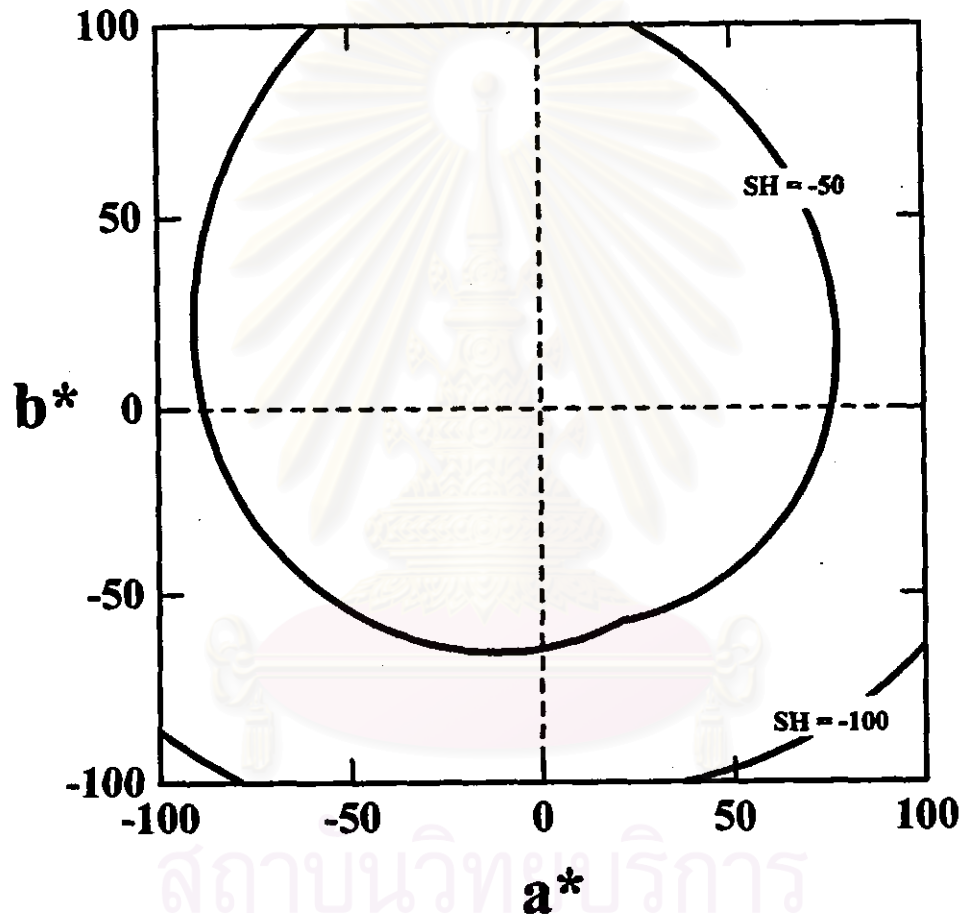


Figure 4-40 ISO-SH lines on CIE a* b* (L* = 50) plane

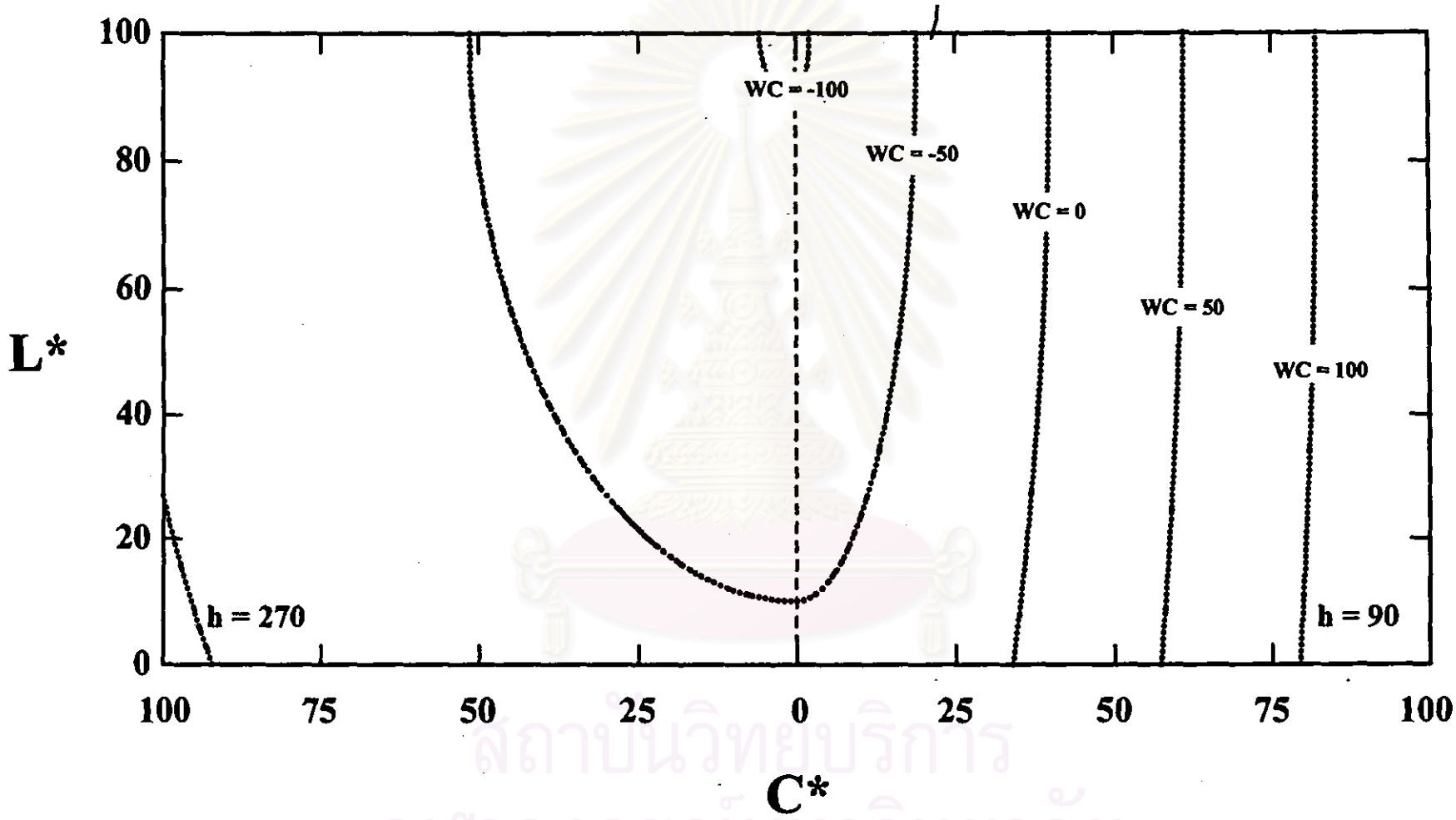


Figure 4-41 ISO-WC lines on CIE L* C* (h= 90 and h=270) plane

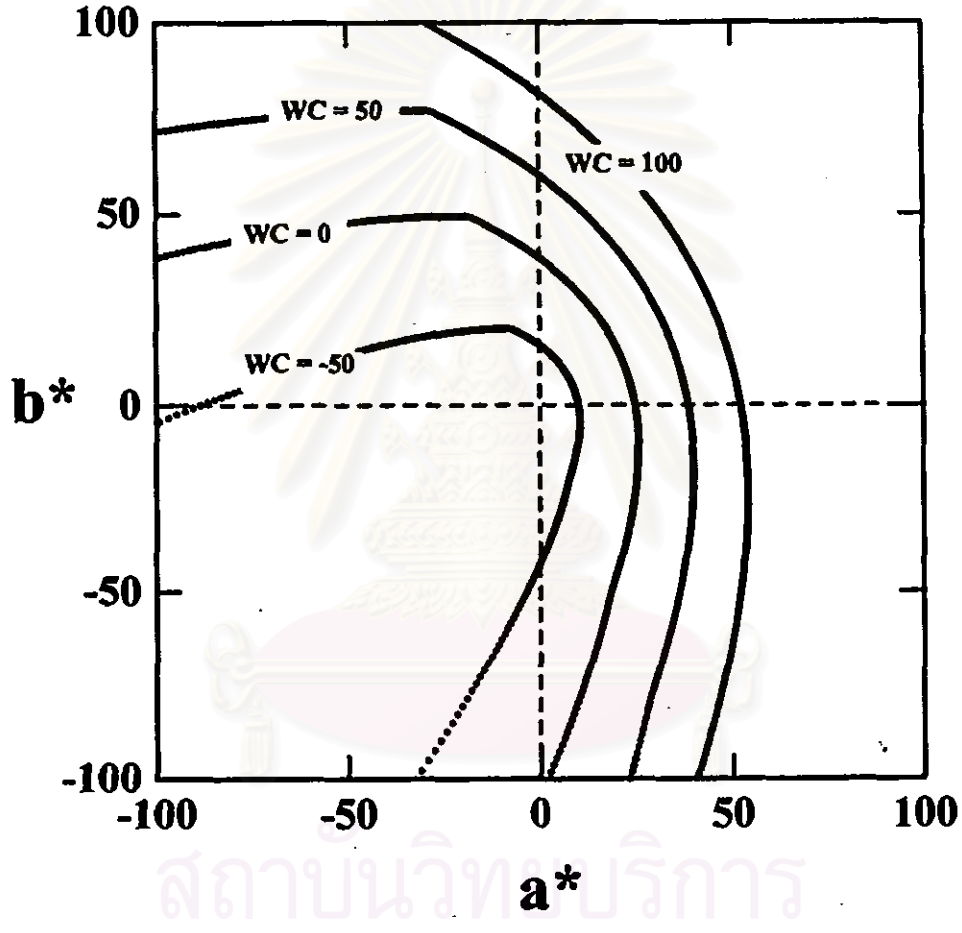


Figure 4-42 ISO-WC lines on CIE a* b* (L* = 50) plane

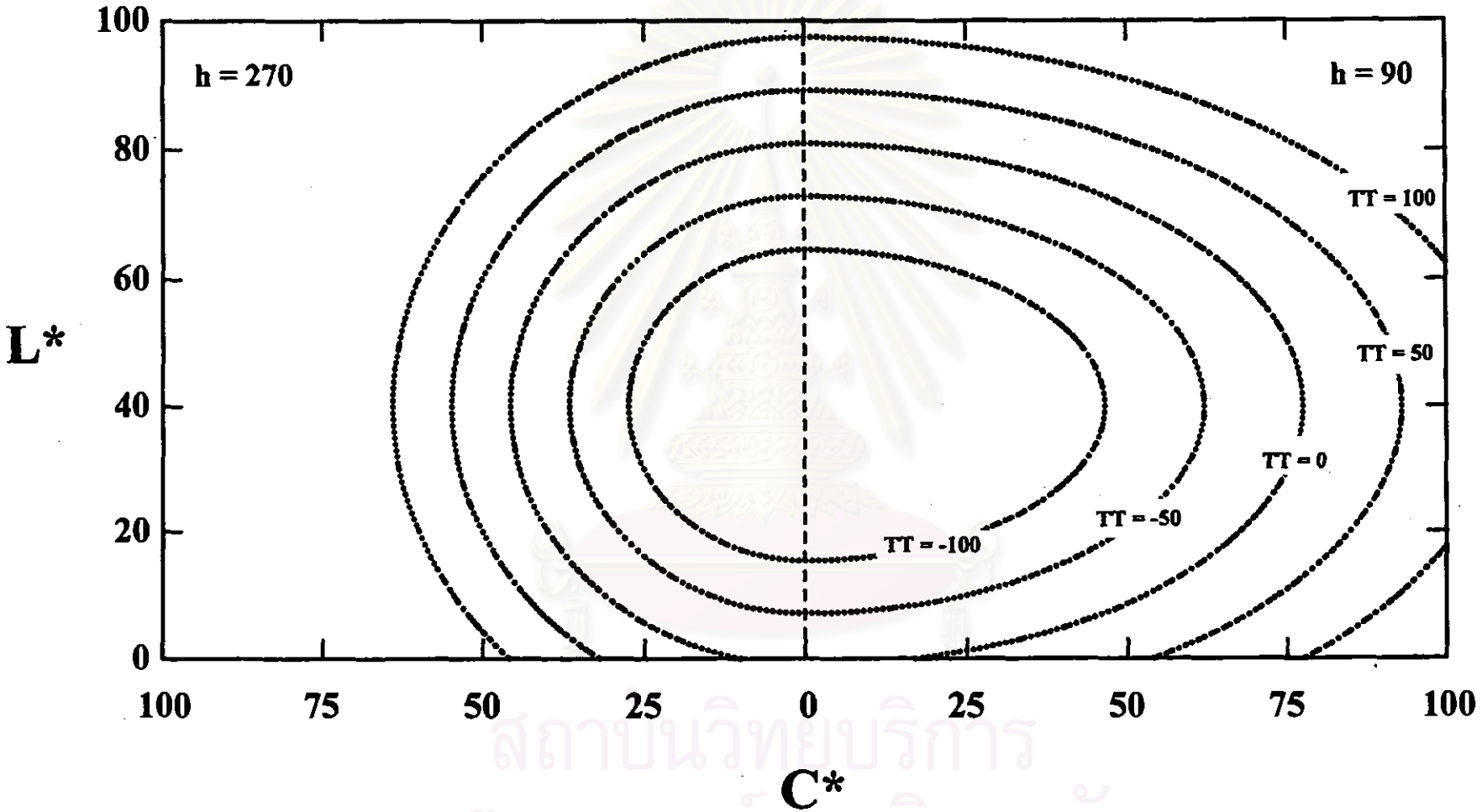


Figure 4-43 ISO-TT lines on CIE L* C* (h= 90 and h=270) plane

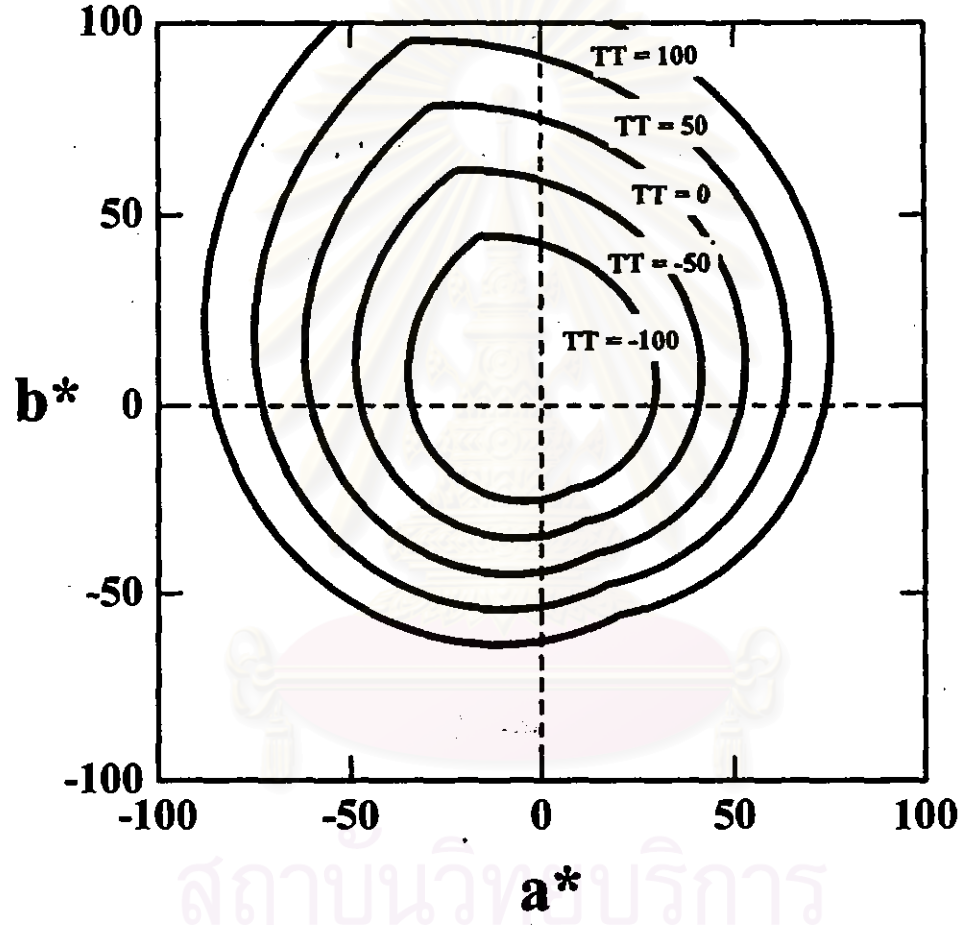


Figure 4-44 ISO-TT lines on CIE a* b* (L* = 50) plane

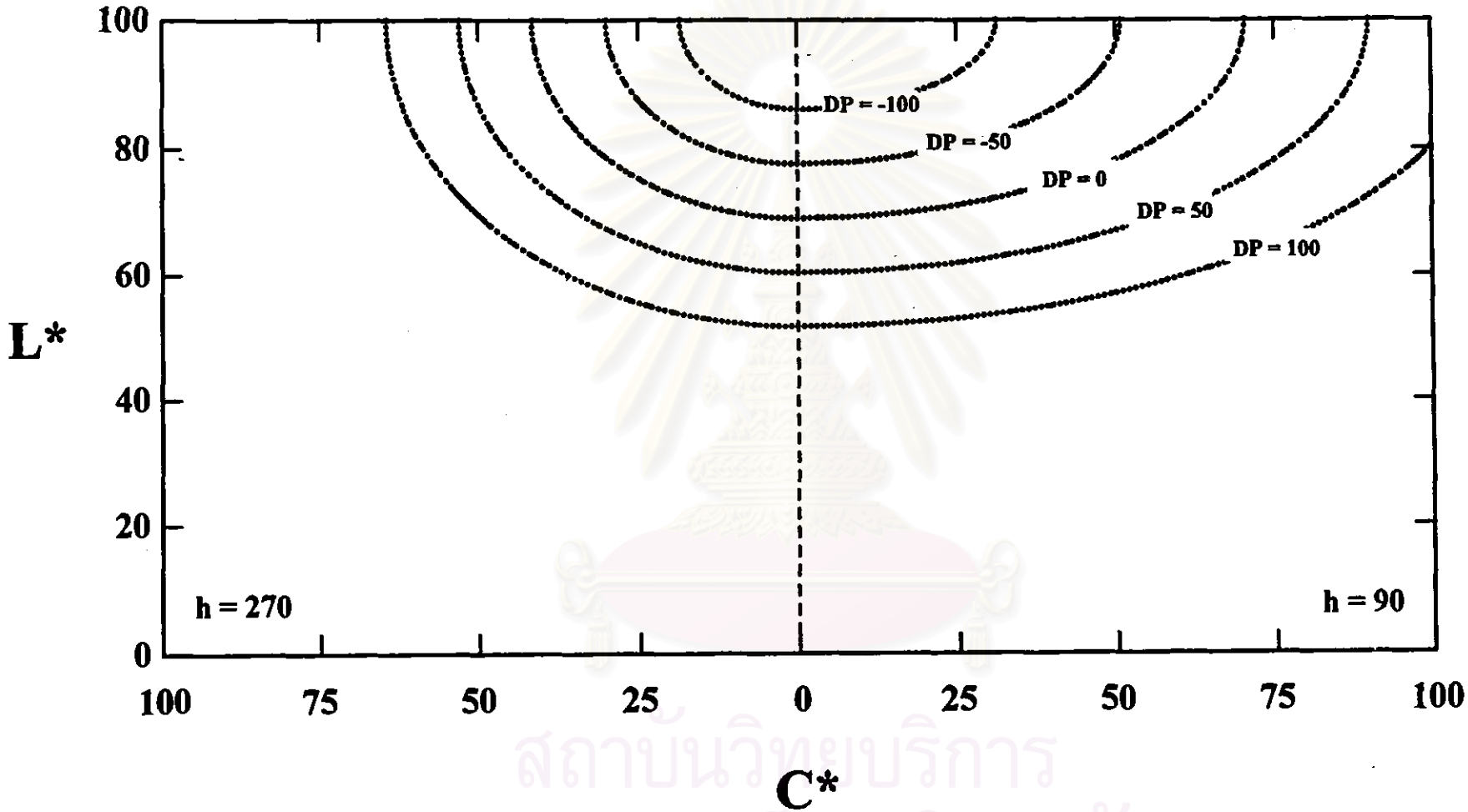


Figure 4-45 ISO-DP lines on CIE L* C* (h= 90 and h=270) plane

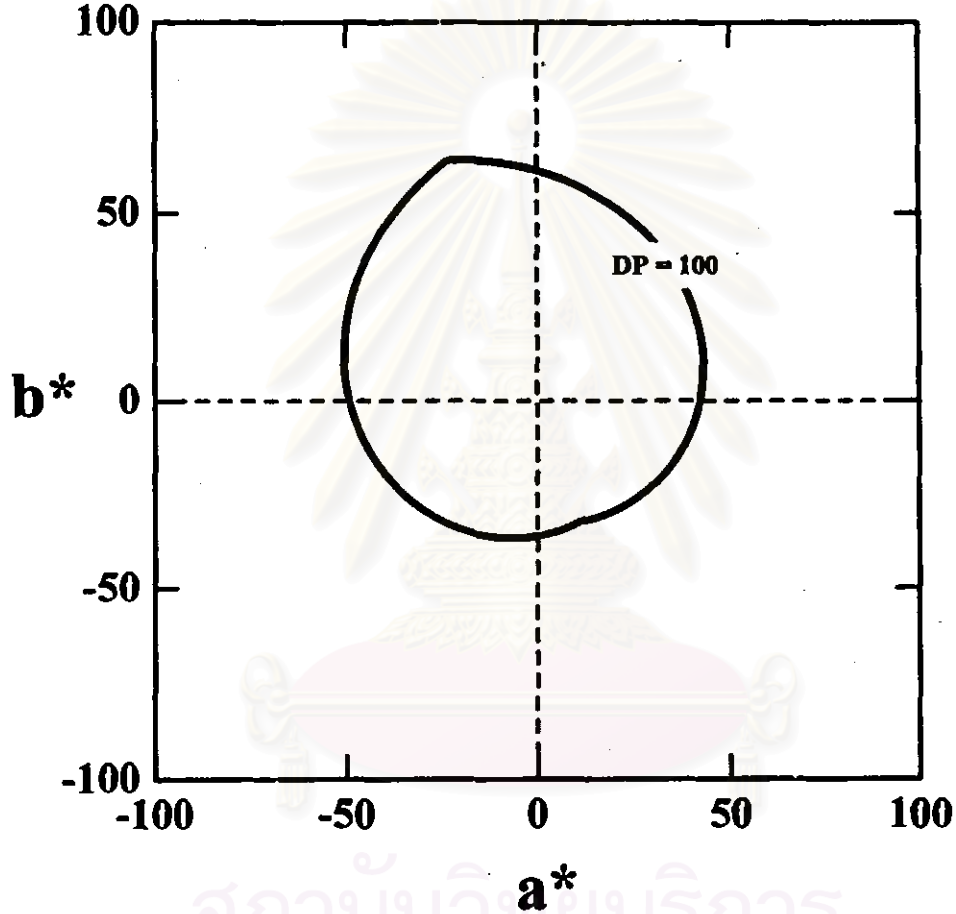


Figure 4-46 ISO-DP lines on CIE a* b* (L* = 60) plane

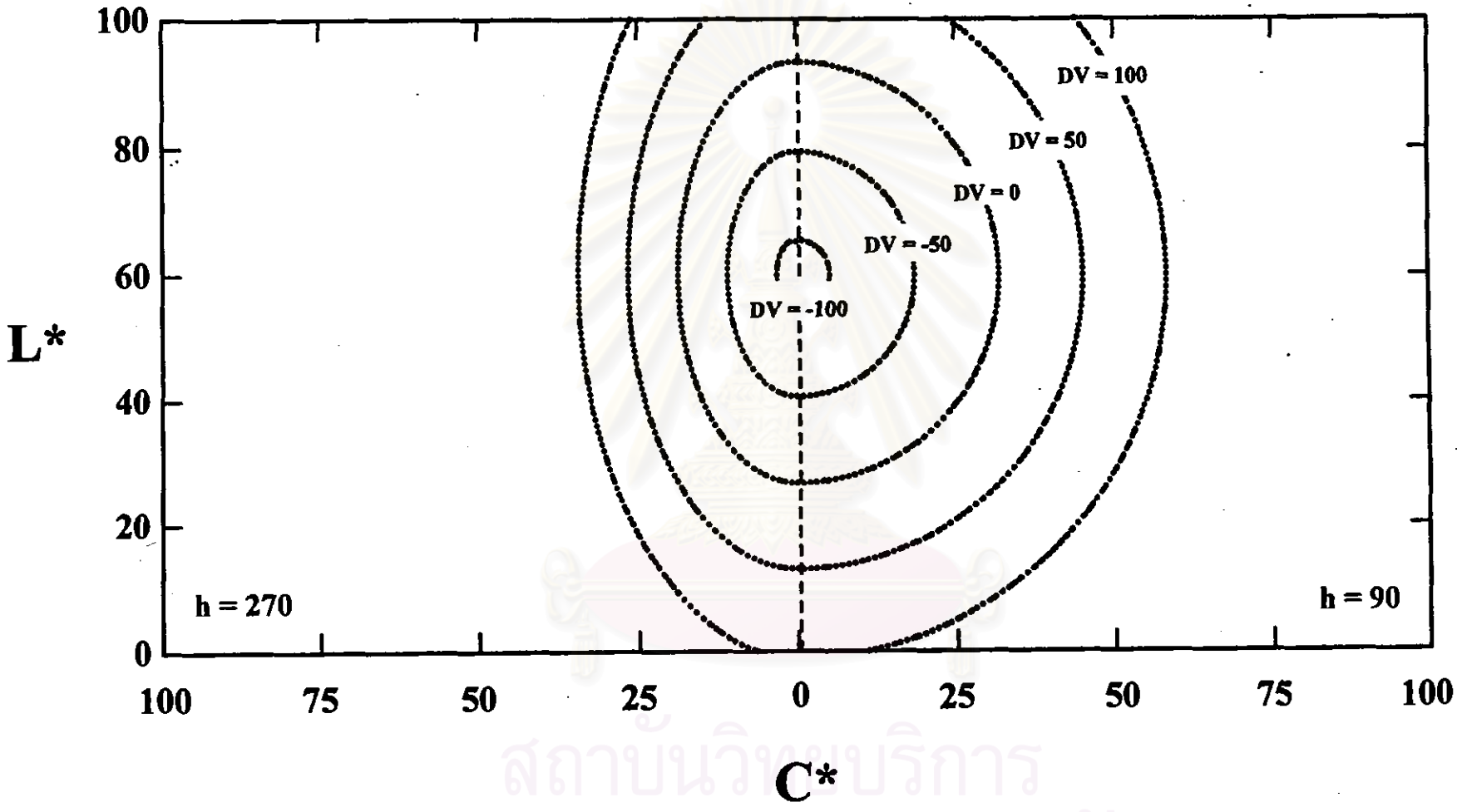


Figure 4-47 ISO-DV lines on CIE L* C* (h= 90 and h=270) plane

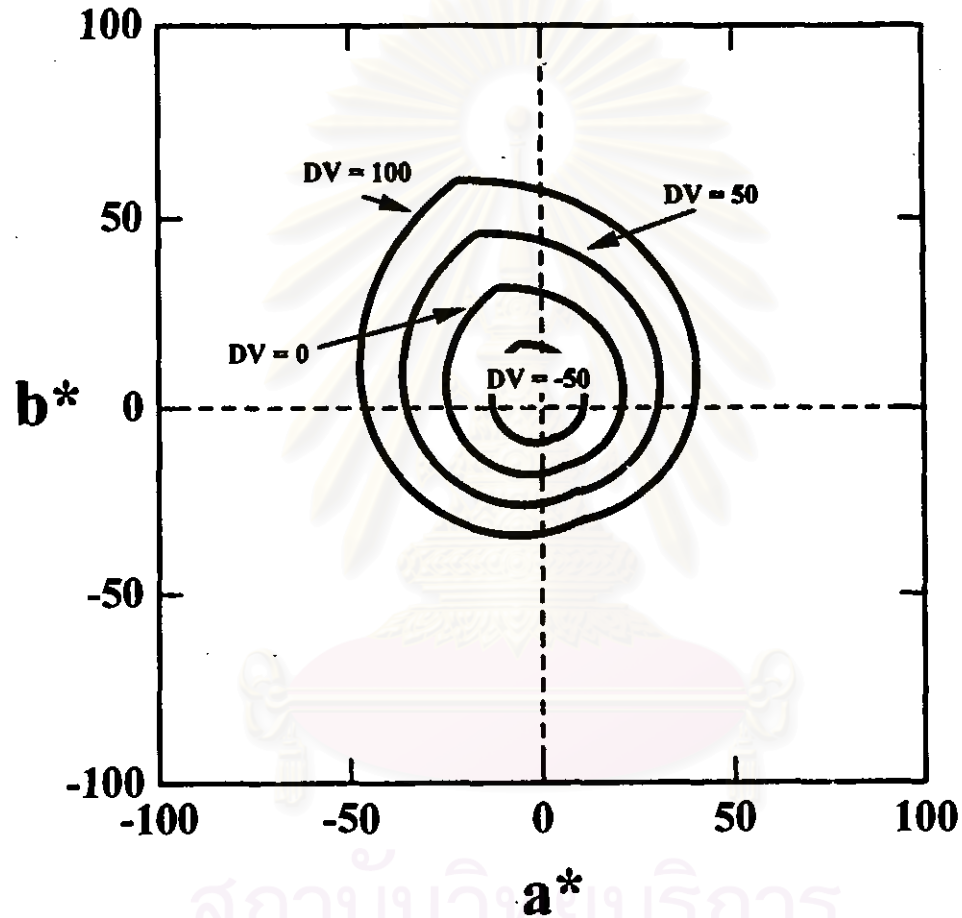


Figure 4-48 ISO-DV lines on CIE a* b* (L* = 50) plane

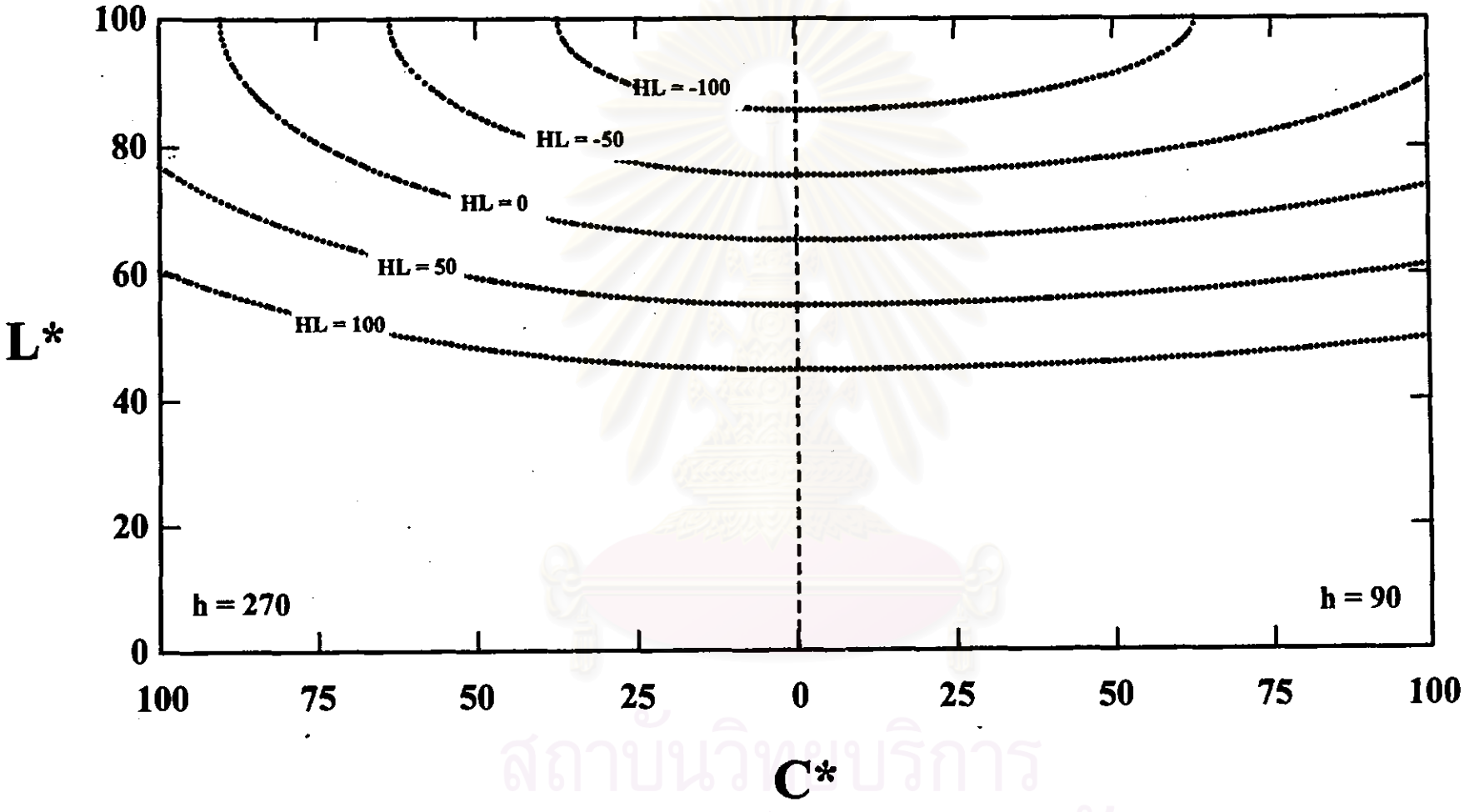


Figure 4-49 ISO-HL lines on CIE L* C* (h= 90 and h=270) plane

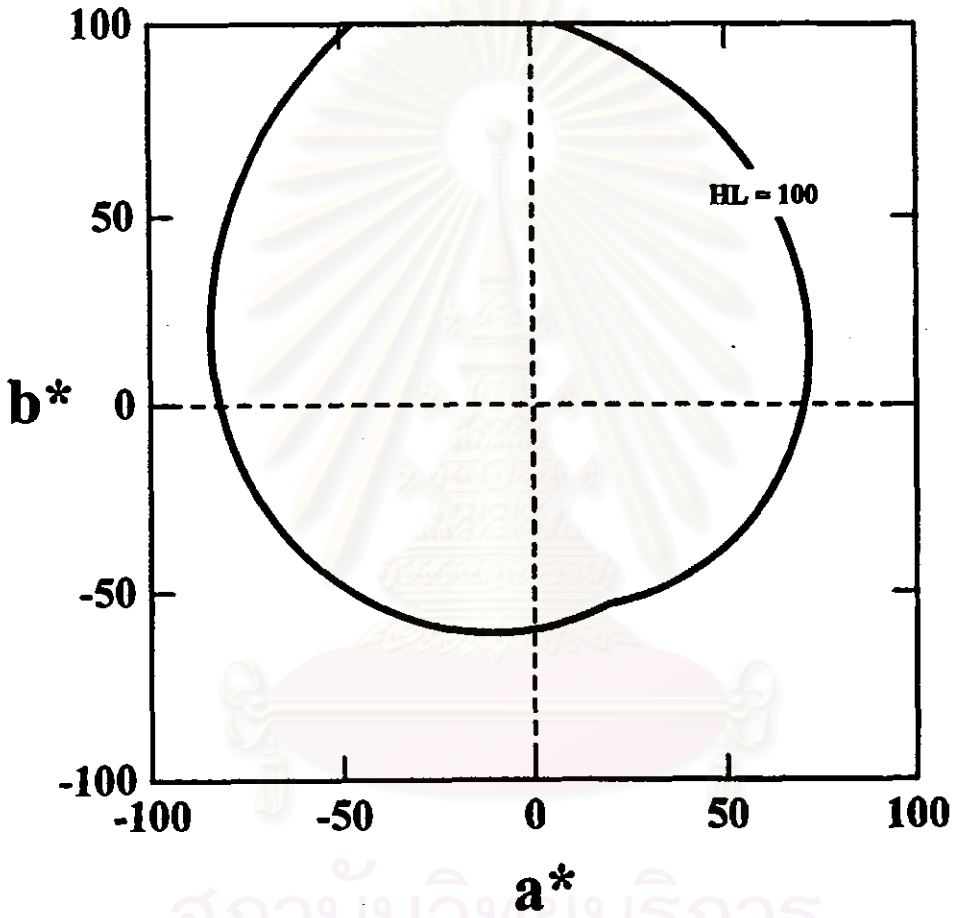


Figure 4-50 ISO-HL lines on CIE a* b* (L* = 50) plane

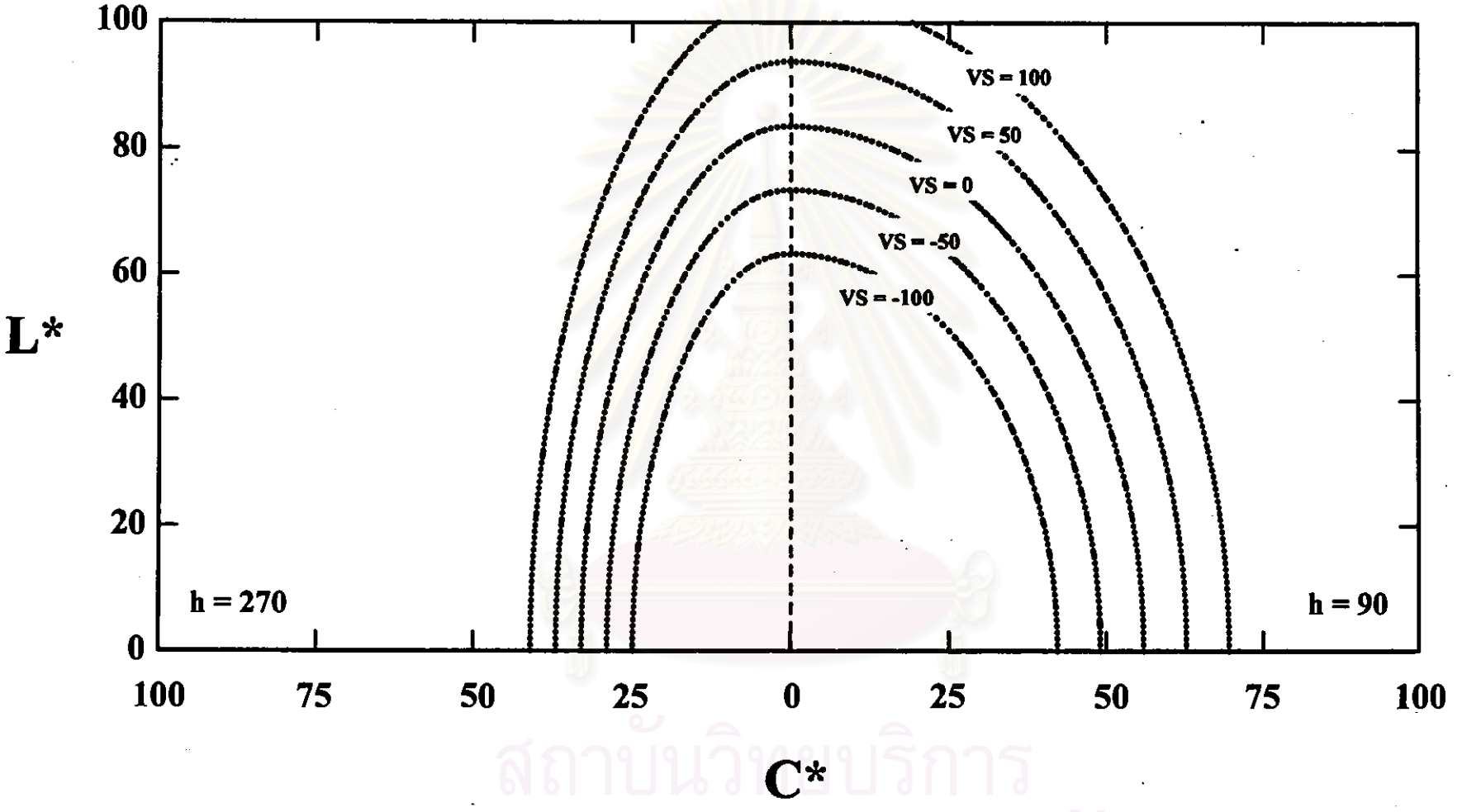


Figure 4-51 ISO-VS lines on CIE L* C* (h= 90 and h=270) plane

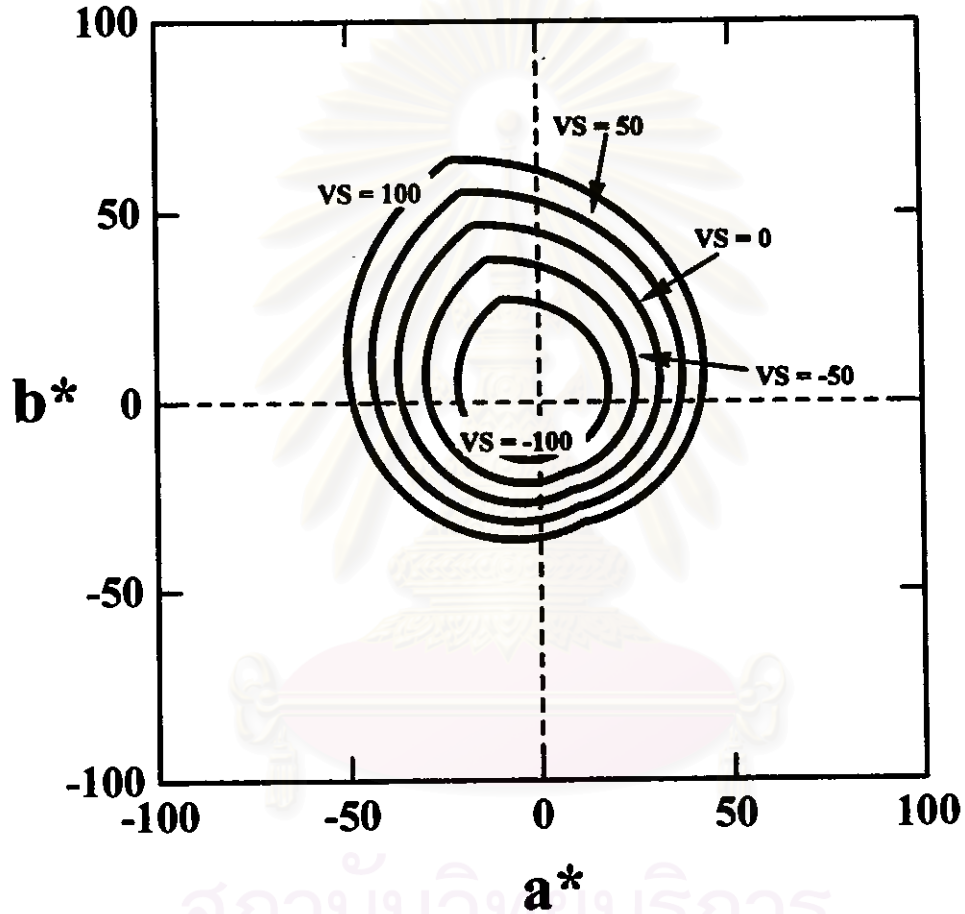


Figure 4-52 ISO-VS lines on CIE a* b* (L* = 50) plane

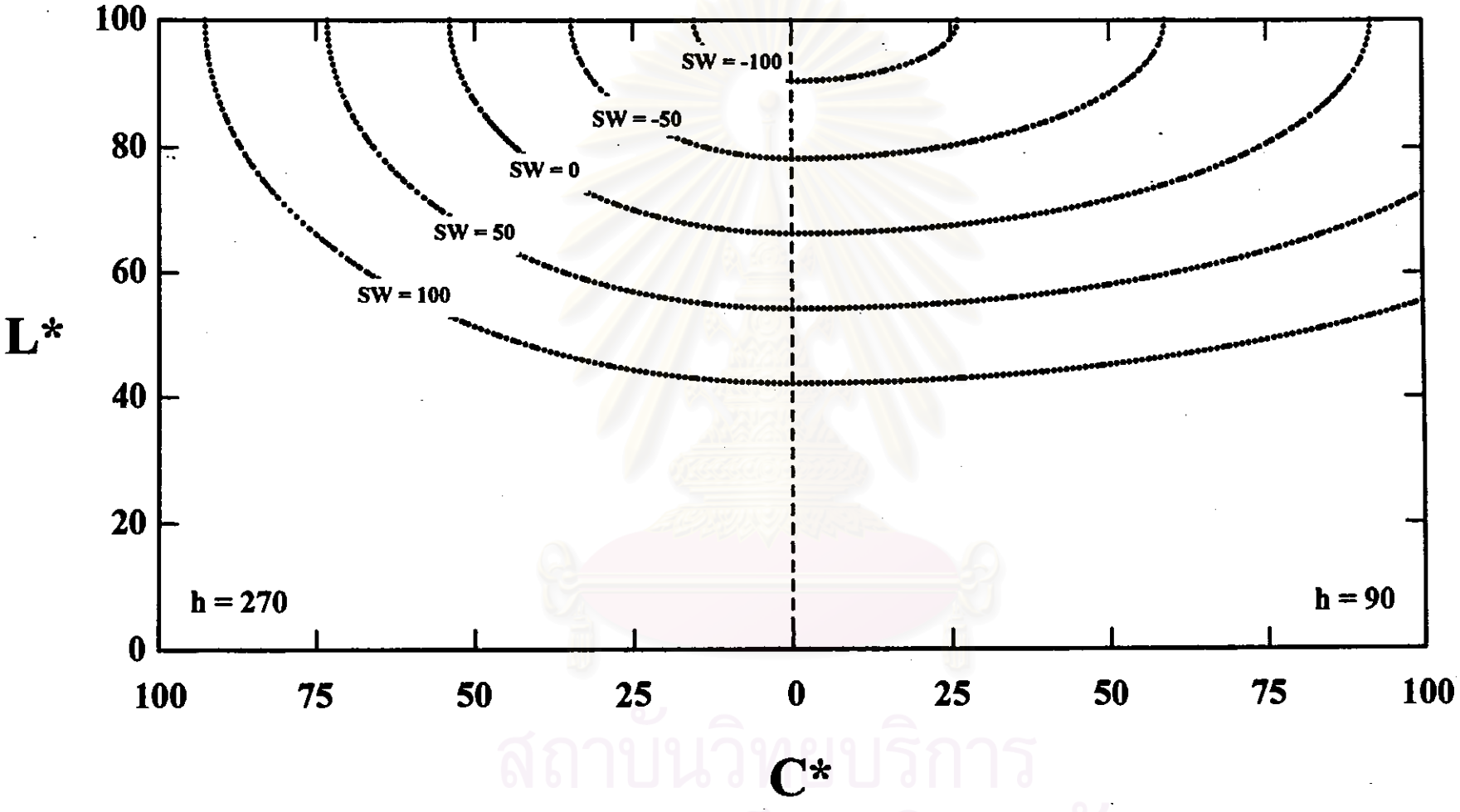


Figure 4-53 ISO-SW lines on CIE L* C* (h= 90 and h=270) plane

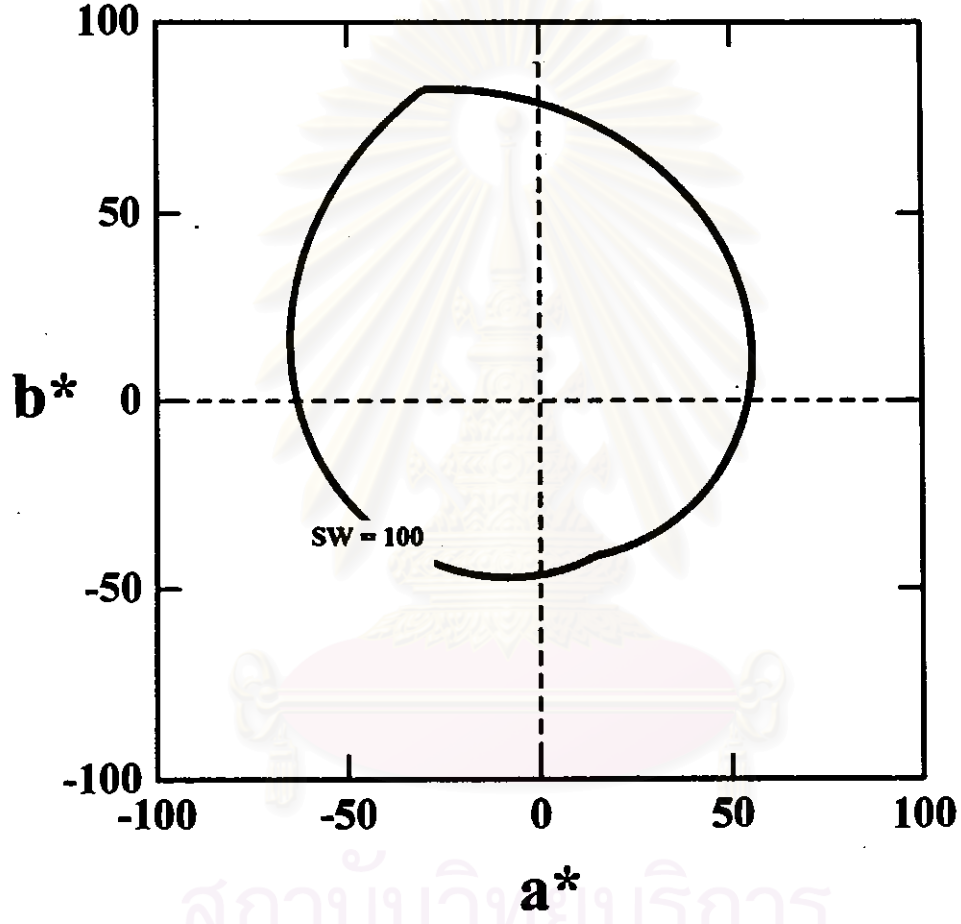


Figure 4-54 ISO-SW lines on CIE a* b* (L* = 50) plane

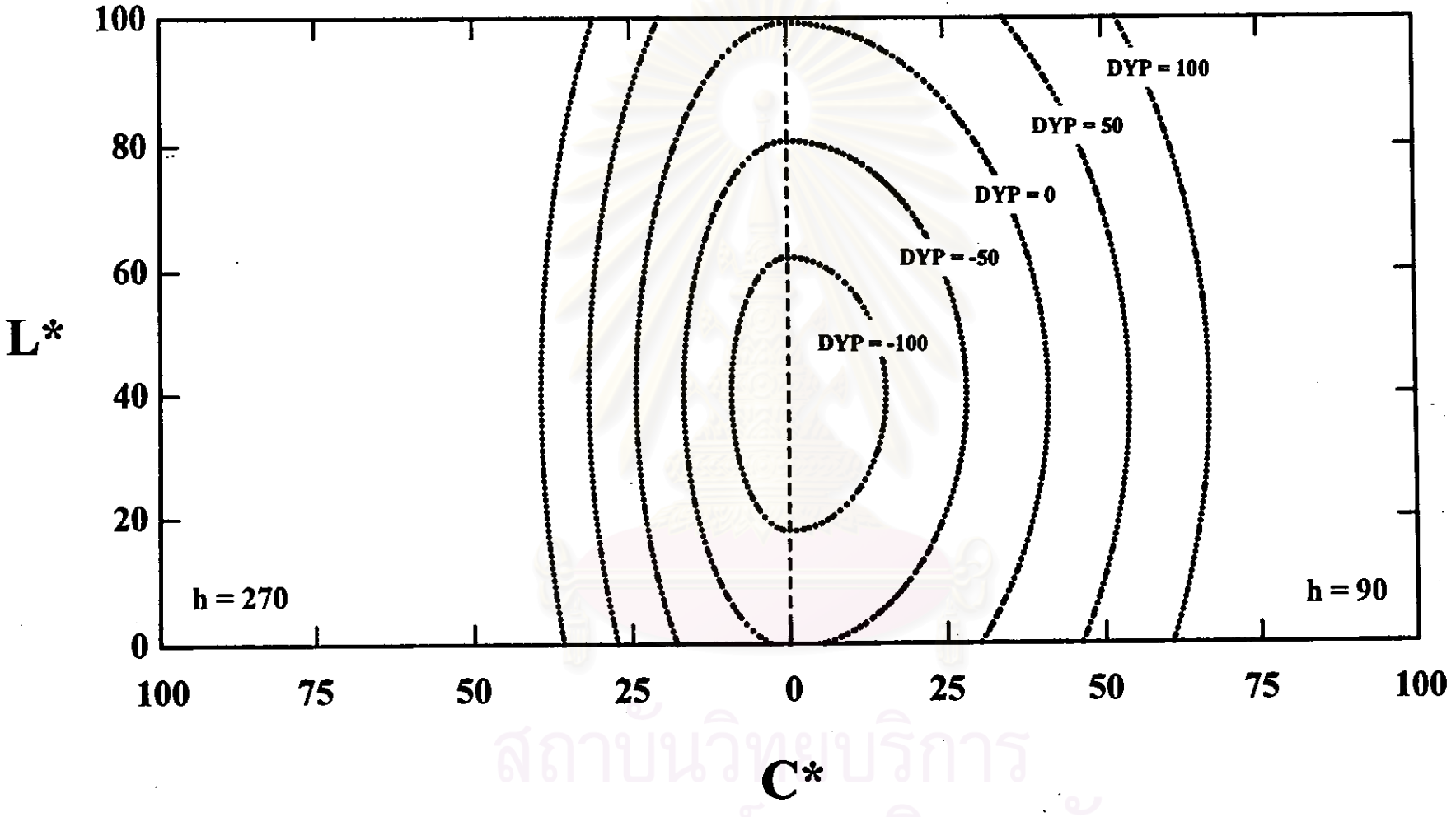


Figure 4-55 ISO-DYP lines on CIE L* C* (h= 90 and h=270) plane

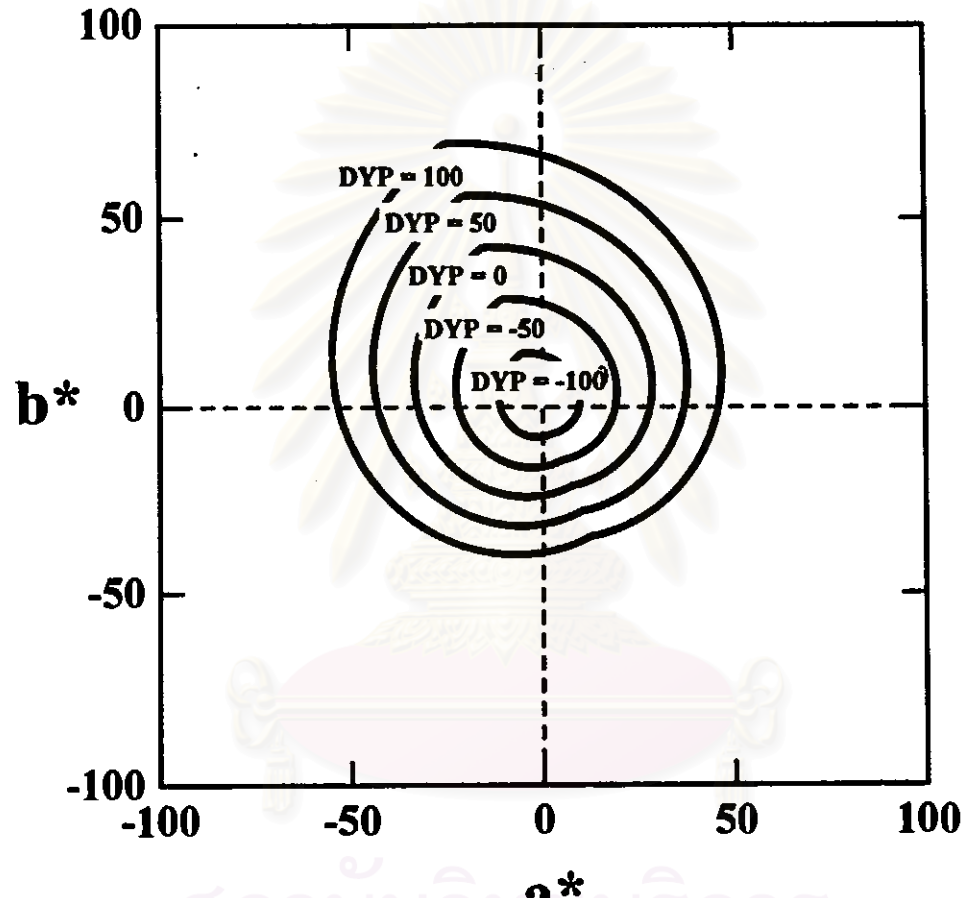


Figure 4-56 ISO-DYP lines on CIE a* b* (L* = 50) plane

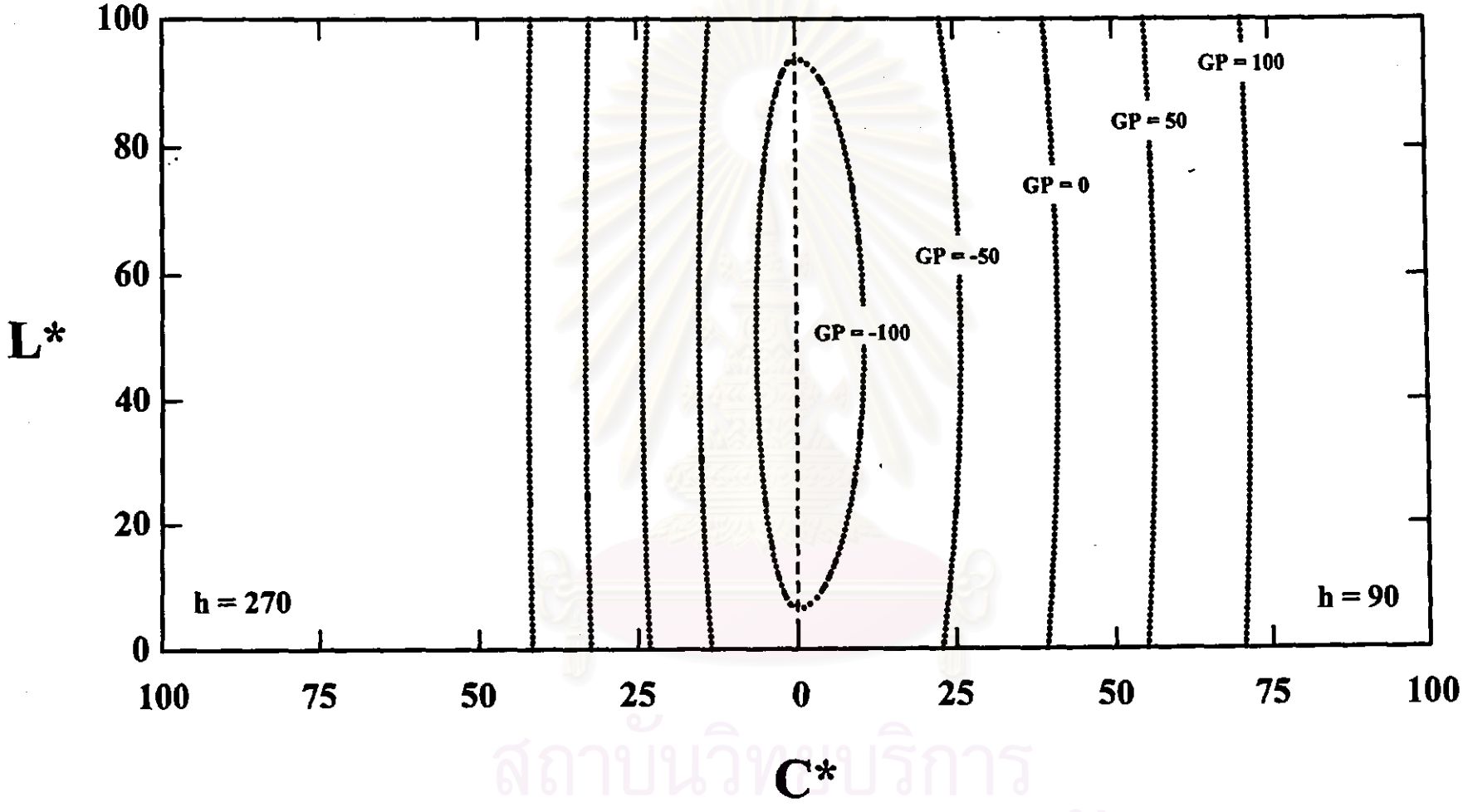


Figure 4-57 ISO-GP lines on CIE L* C* (h= 90 and h=270) plane

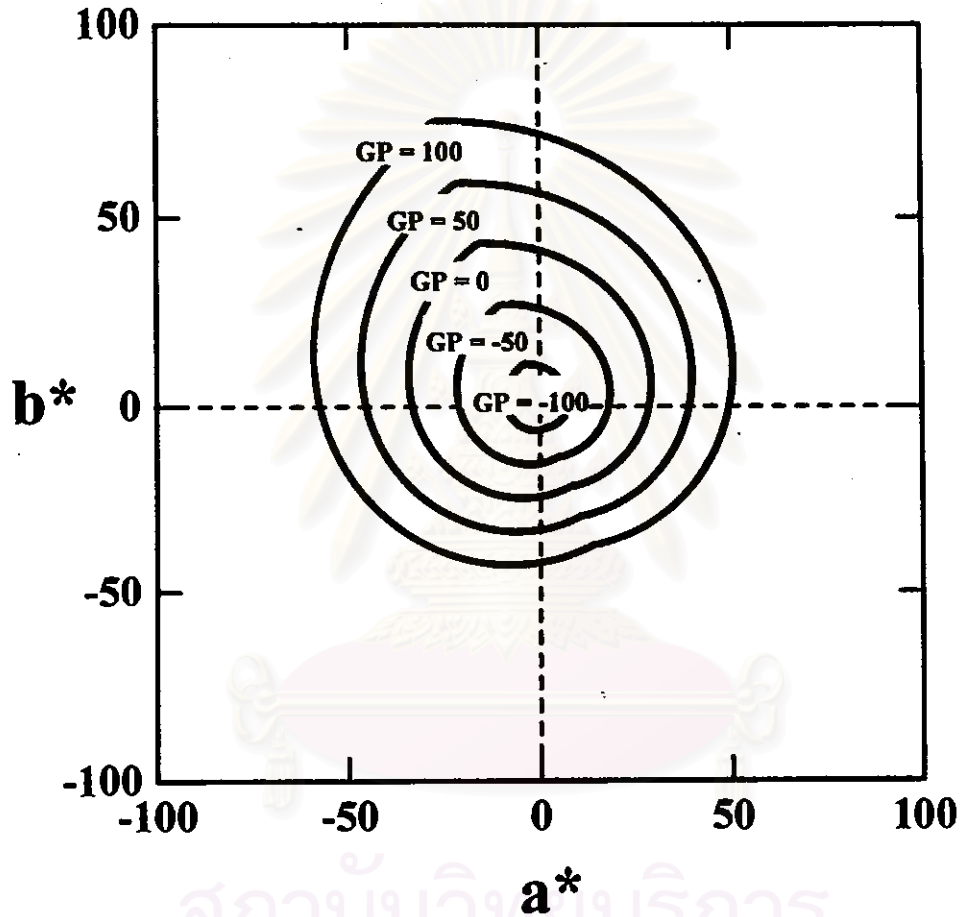


Figure 4-58 ISO-GP lines on CIE a* b* (L* = 50) plane

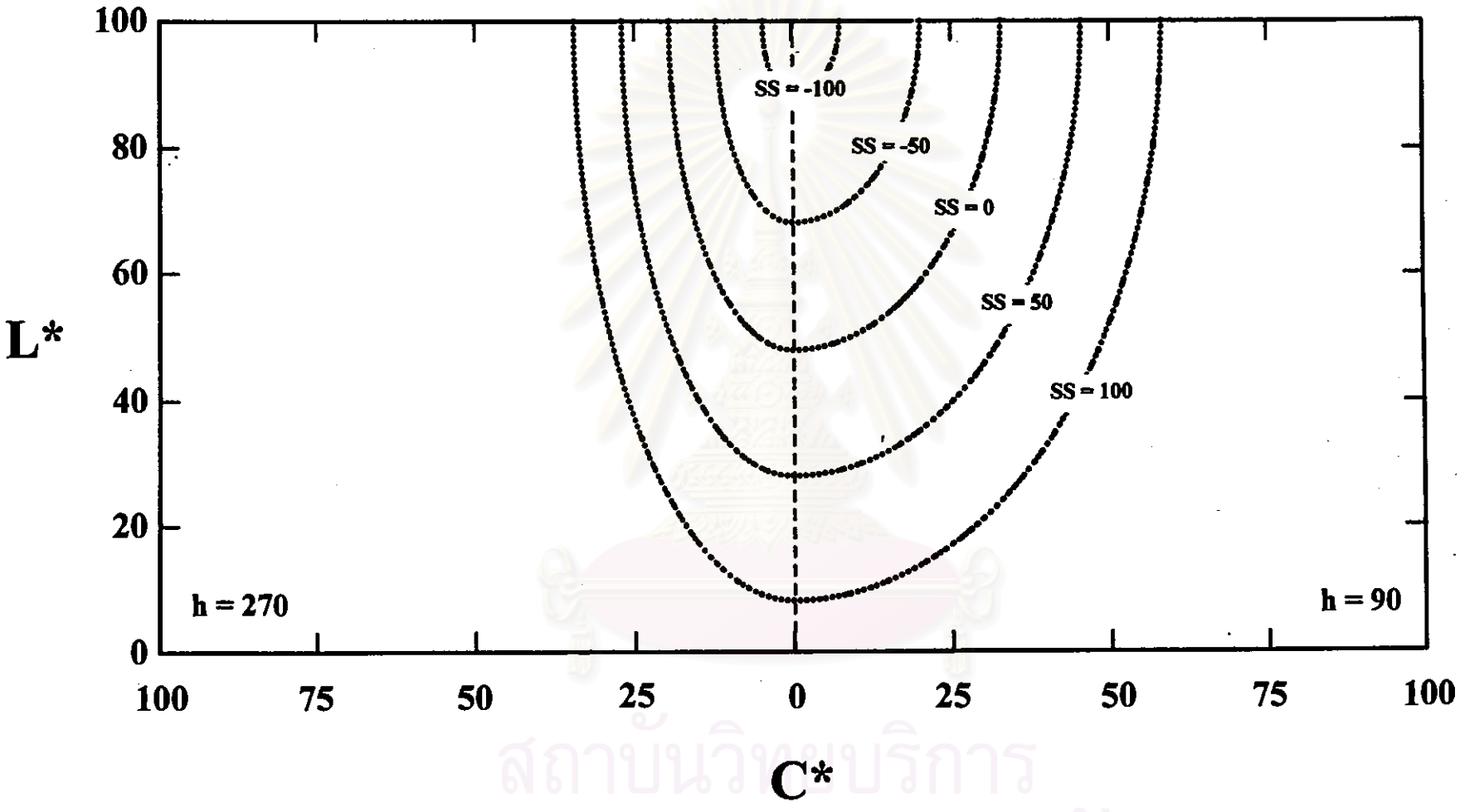


Figure 4-59 ISO-SS lines on CIE L* C* (h= 90 and h=270) plane

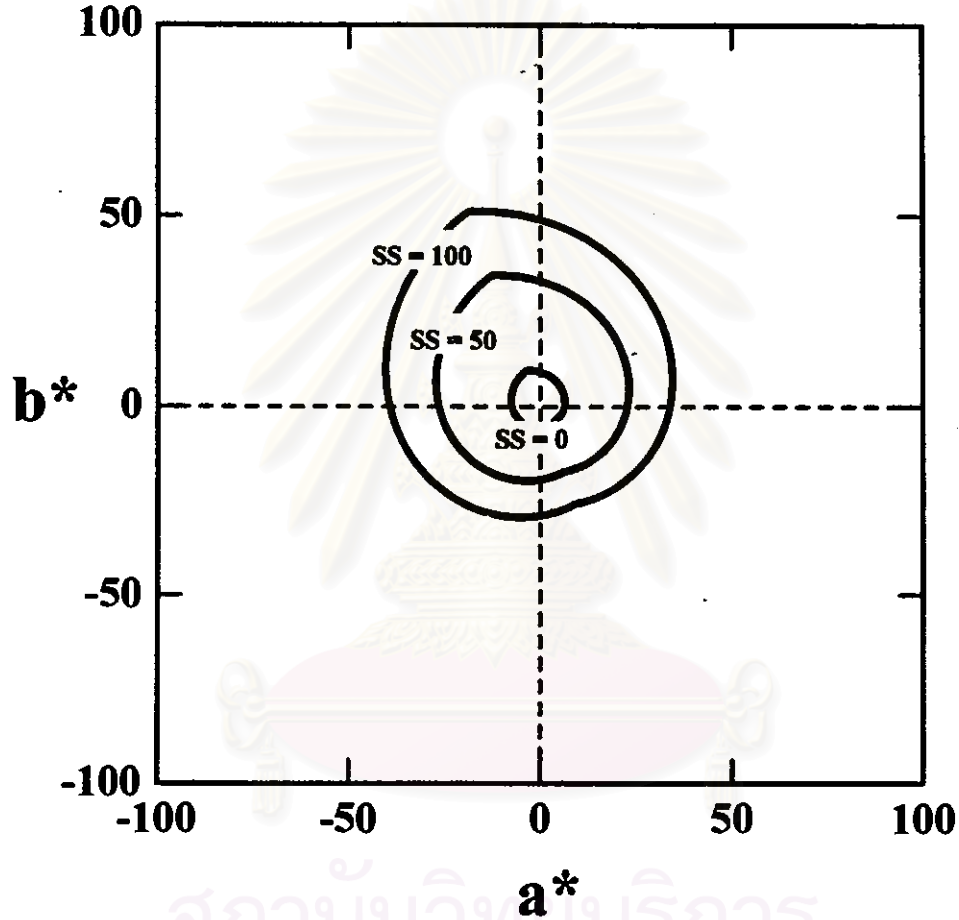


Figure 4-60 ISO-SS lines on CIE a* b* (L* = 50) plane

4.4 Color Perception Map

The color perception maps between two opponent word pairs are shown in Figure 4-61 to Figure 4-126. These diagrams show the degree of the color perception and are useful for determining the relationship between the color perception words. For example, in Figure 4-95, the color perception of "DP" gives a similar respond to that of "SW", while in Figure 4-78, the color perception of "SH" describes the opposite respond to that of "SW". The color perception maps are also found as a useful tool for color designing and color planing.

4.5 Correlation Coefficients of Visual Assessment

The correlation coefficients is the other simply way to describe the relationship between the opponent word pairs. The correlation coefficients of visual assessment are shown in Table 4-2.

The higher the correlation coefficients are, the more similar results between two opponent word. In Table 4-2, the correlation coefficients of greater than 9.000 are as follow

"Light-Dark" and "Transparent-Turbid" = 0.9430,
"Deep-Pale" and "Heavy-Light" = 0.9504,
"Deep-Pale" and "Strong-Weak" = 0.9530,
"Vivid-Sombre" and "Dynamic-Passive" = 0.9201,
"Strong-Weak" and "Heavy-Light" = 0.9567,
"Dynamic-Passive" and "Gaudy-Plain" = 0.9284,

Table 4-2 Correlation coefficients between the visual assessments against twelve color perceptions

Symbol	LD	SH	WC	TT	DP	DV	HL	VS	SW	DYP	GP	SS
LD	1	0.82376	0.31018	**0.94302**	-0.6121	0.40841	-0.77	0.83492	-0.6963	0.71811	0.52868	-0.1203
SH	0.82376	1	-0.1549	0.85118	-0.8172	0.01046	-0.9135	0.54455	-0.8868	0.35086	0.09731	-0.4929
WC	0.31018	-0.1549	1	0.21388	0.32649	0.62473	0.19118	0.51287	0.23316	0.68727	0.77573	0.60154
TT	**0.94302**	0.85118	0.21388	1	-0.6796	0.38412	-0.8361	0.81521	-0.7495	0.64005	0.44698	-0.1706
DP	-0.6121	-0.8172	0.21388	-0.6796	1	0.3102	**0.95036**	-0.2044	**0.95303**	0.0567	0.28833	0.78124
DV	0.40841	0.01046	0.62473	0.38412	0.3102	1	0.09595	0.79179	0.23301	0.83208	0.87863	0.80054
HL	-0.77	-0.9135	0.19118	-0.8361	**0.95036**	0.09595	1	-0.4282	**0.95675**	-0.1801	0.05789	0.62276
VS	0.83492	0.54455	0.51287	0.81521	-0.2044	0.79179	-0.4282	1	-0.3063	**0.92013**	0.82576	0.3649
SW	-0.6963	-0.8868	0.23316	-0.7495	**0.95303**	0.23301	**0.95675**	-0.3063	1	-0.0739	0.17812	0.71322
DYP	0.71811	0.35086	0.68727	0.64005	0.0567	0.83208	-0.1801	**0.92013**	-0.0739	1	**0.93844**	0.54847
GP	0.52868	0.09731	0.77573	0.44698	0.28833	0.87863	0.05789	0.82576	0.17812	**0.93844**	1	0.72299
SS	-0.1203	-0.4929	0.60154	-0.1706	0.78124	0.80054	0.62276	0.3649	0.71322	0.54847	0.72299	1

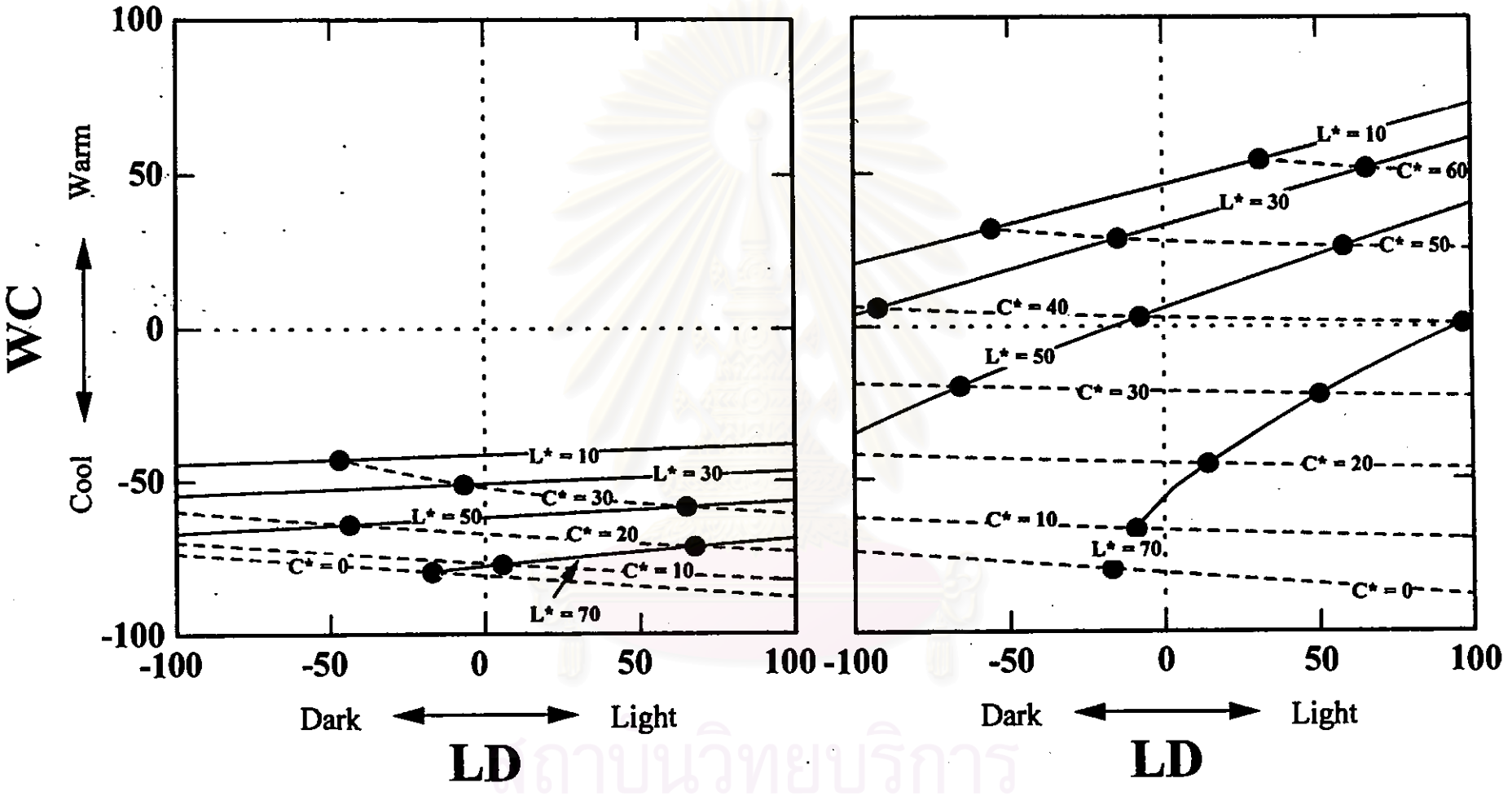


Figure 4-61 The projection of CIELAB color system on LD-WC color perception diagram: (a) h=270, (b) h=90

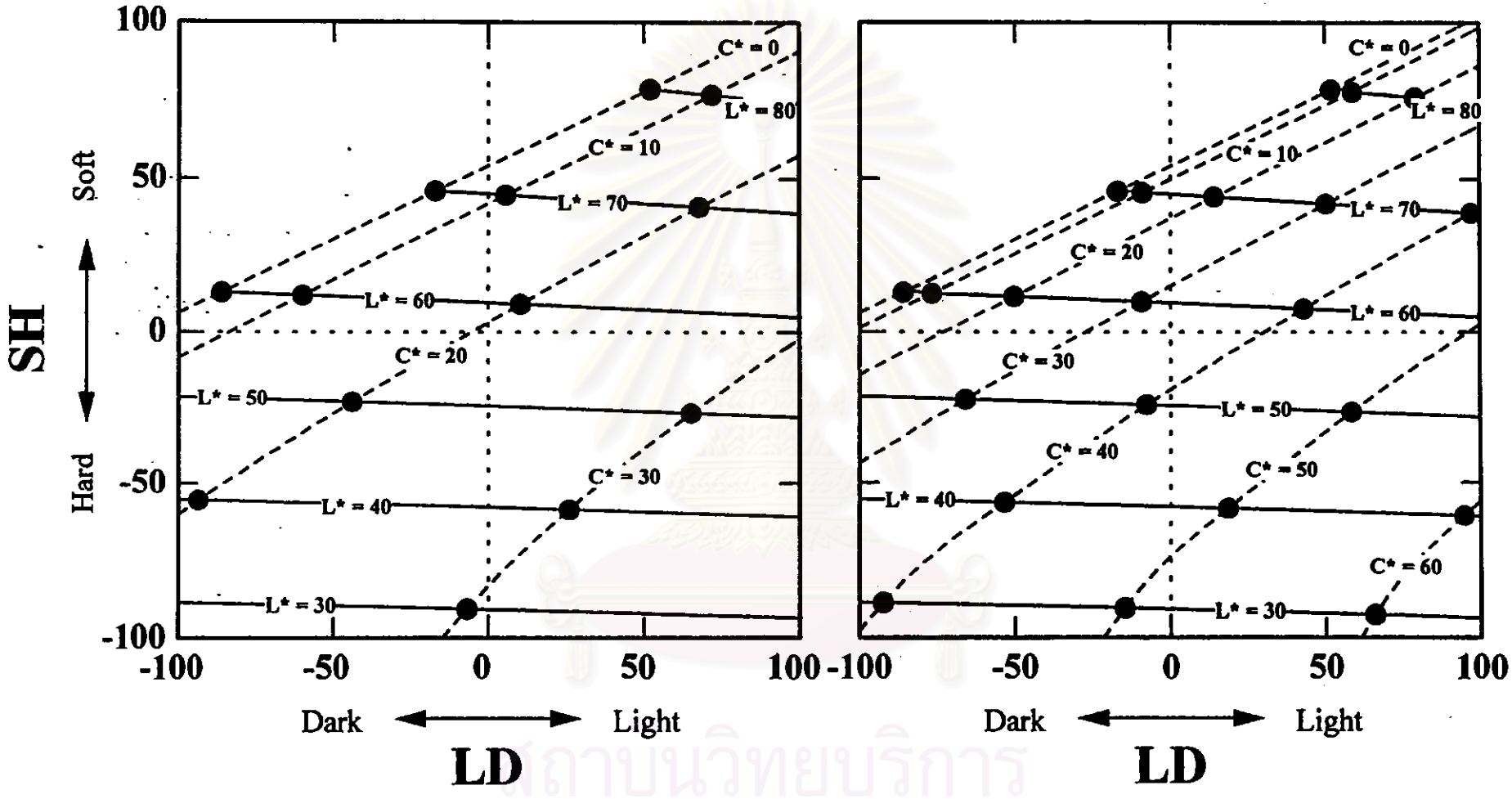


Figure 4-62 The projection of CIELAB color system on LD-SH color perception diagram: (a) h=270, (b) h=90

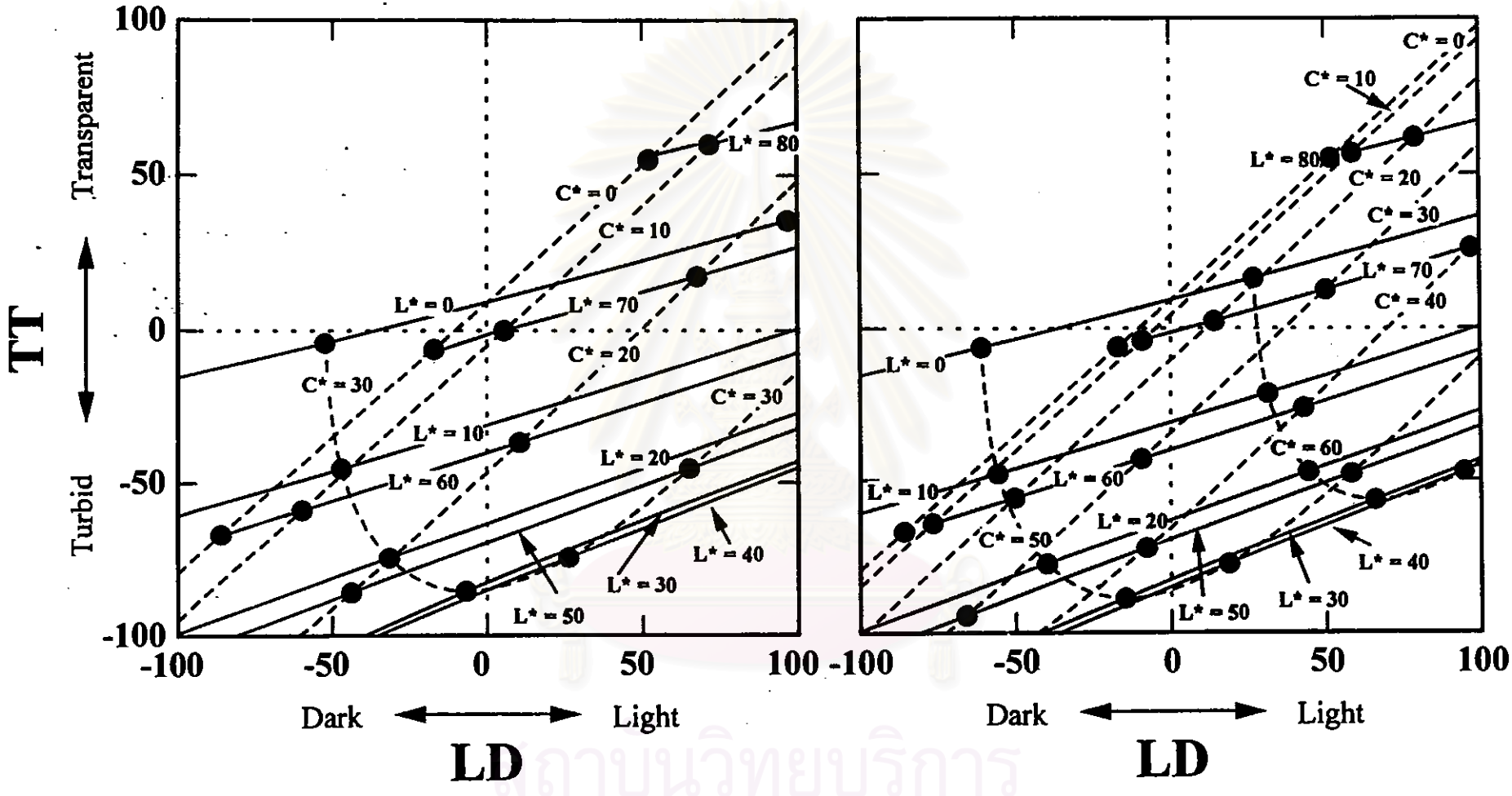


Figure 4-63 The projection of CIELAB color system on LD-TT color perception diagram: (a) h=270, (b) h=90

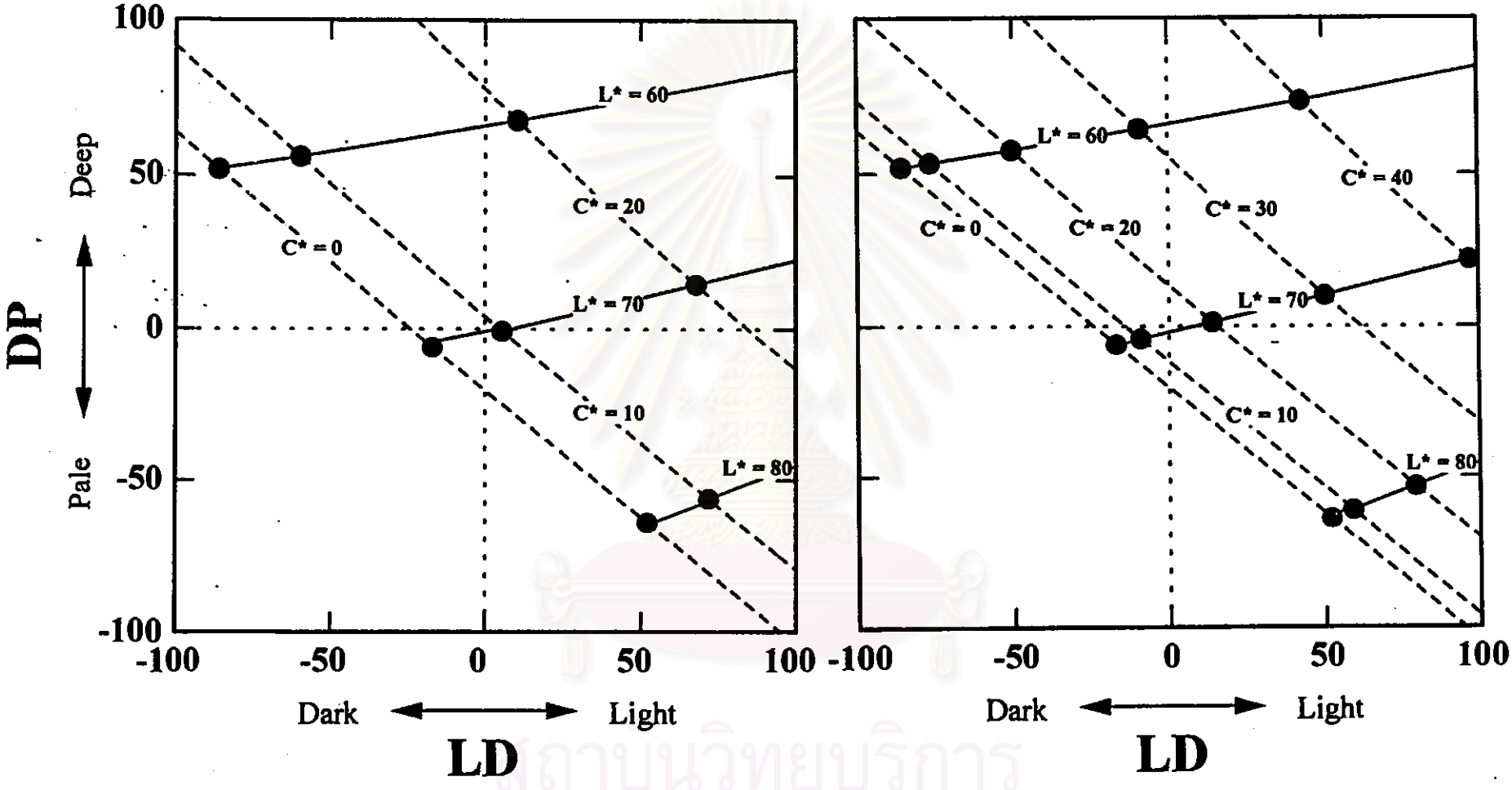


Figure 4-64 The projection of CIELAB color system on LD-DP color perception diagram: (a) h=270, (b) h=90

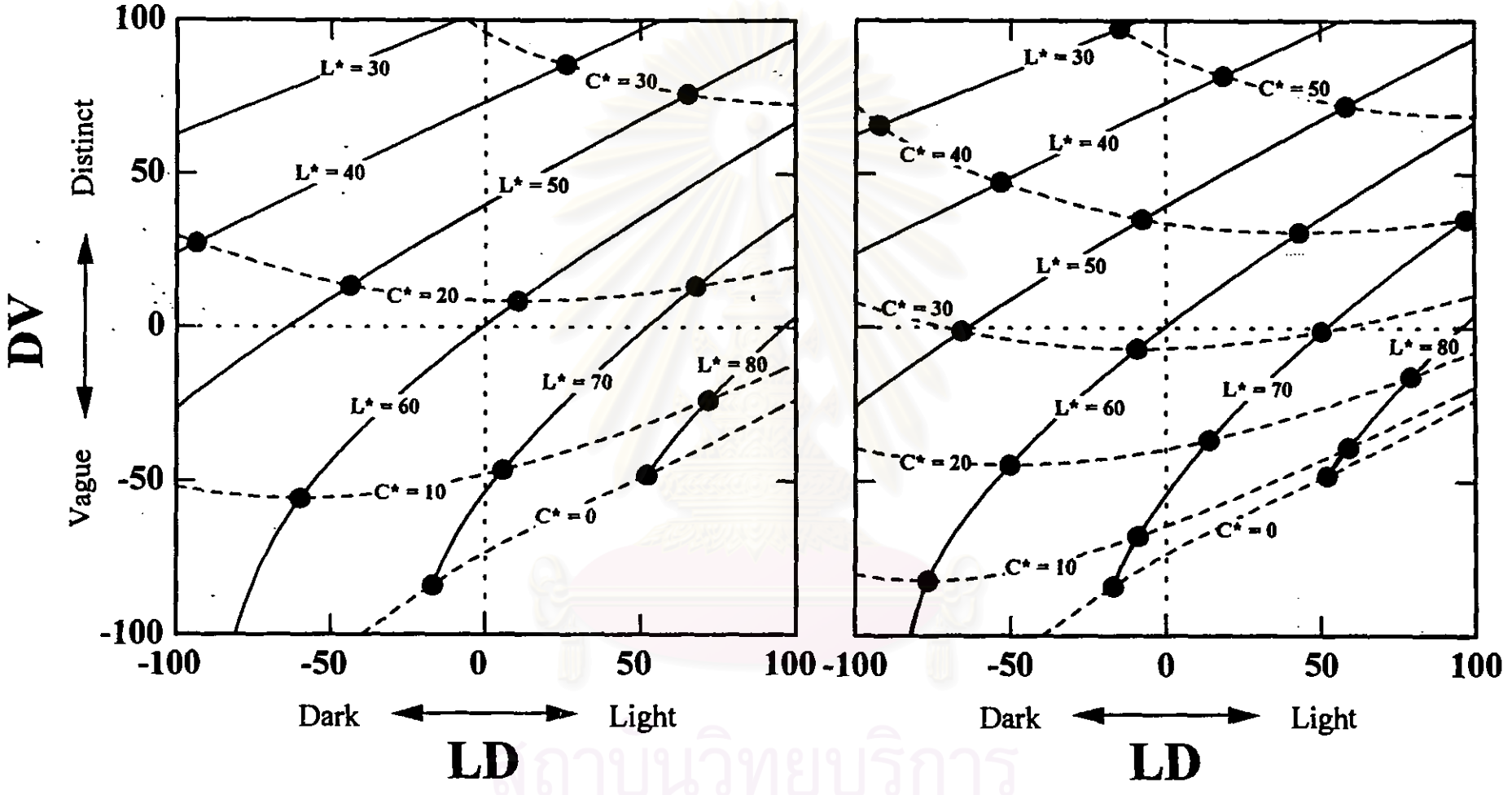


Figure 4-65 The projection of CIELAB color system on LD-DV color perception diagram: (a) h=270, (b) h=90

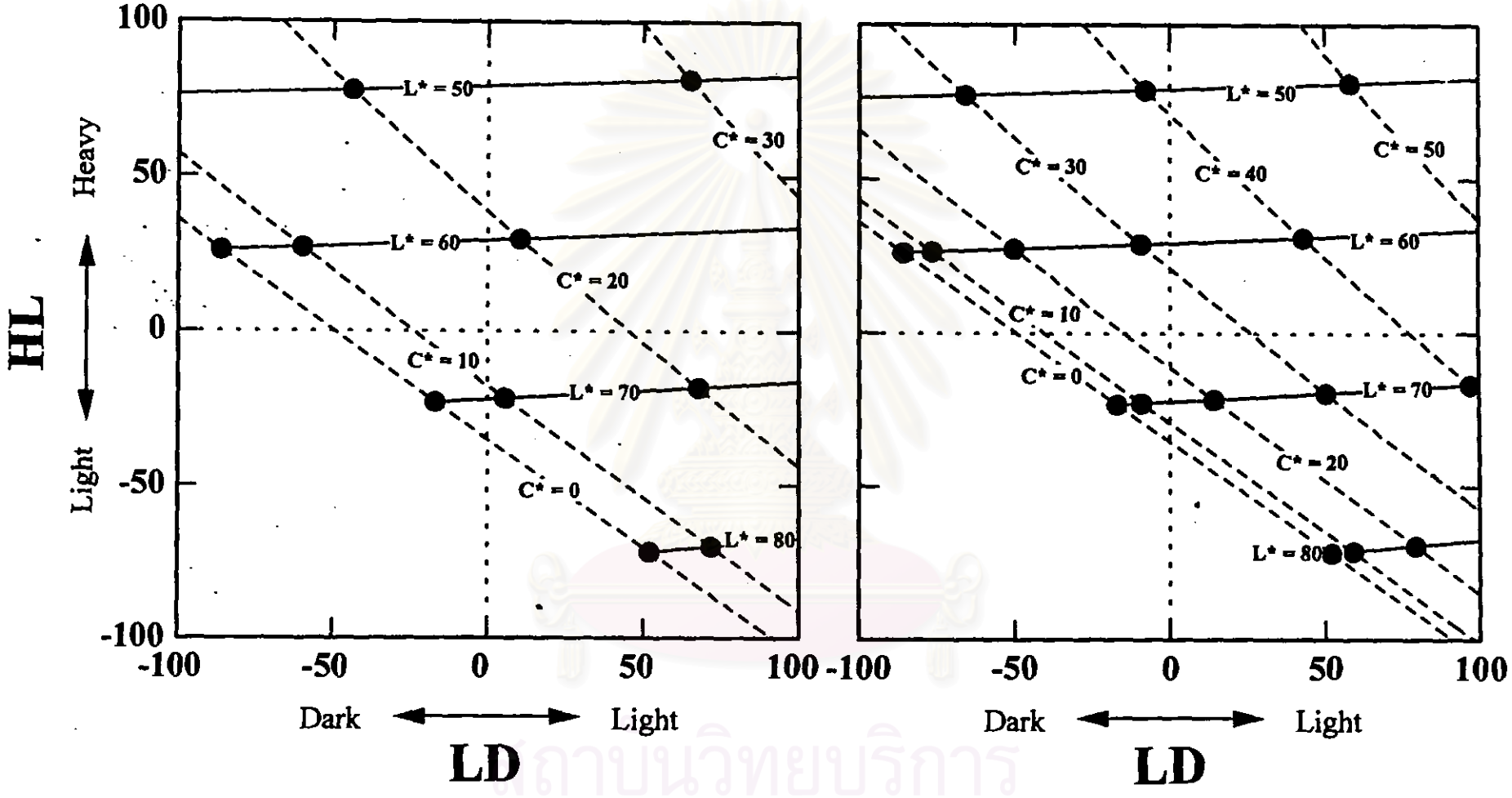


Figure 4-66 The projection of CIELAB color system on LD-HL color perception diagram: (a) h=270, (b) h=90

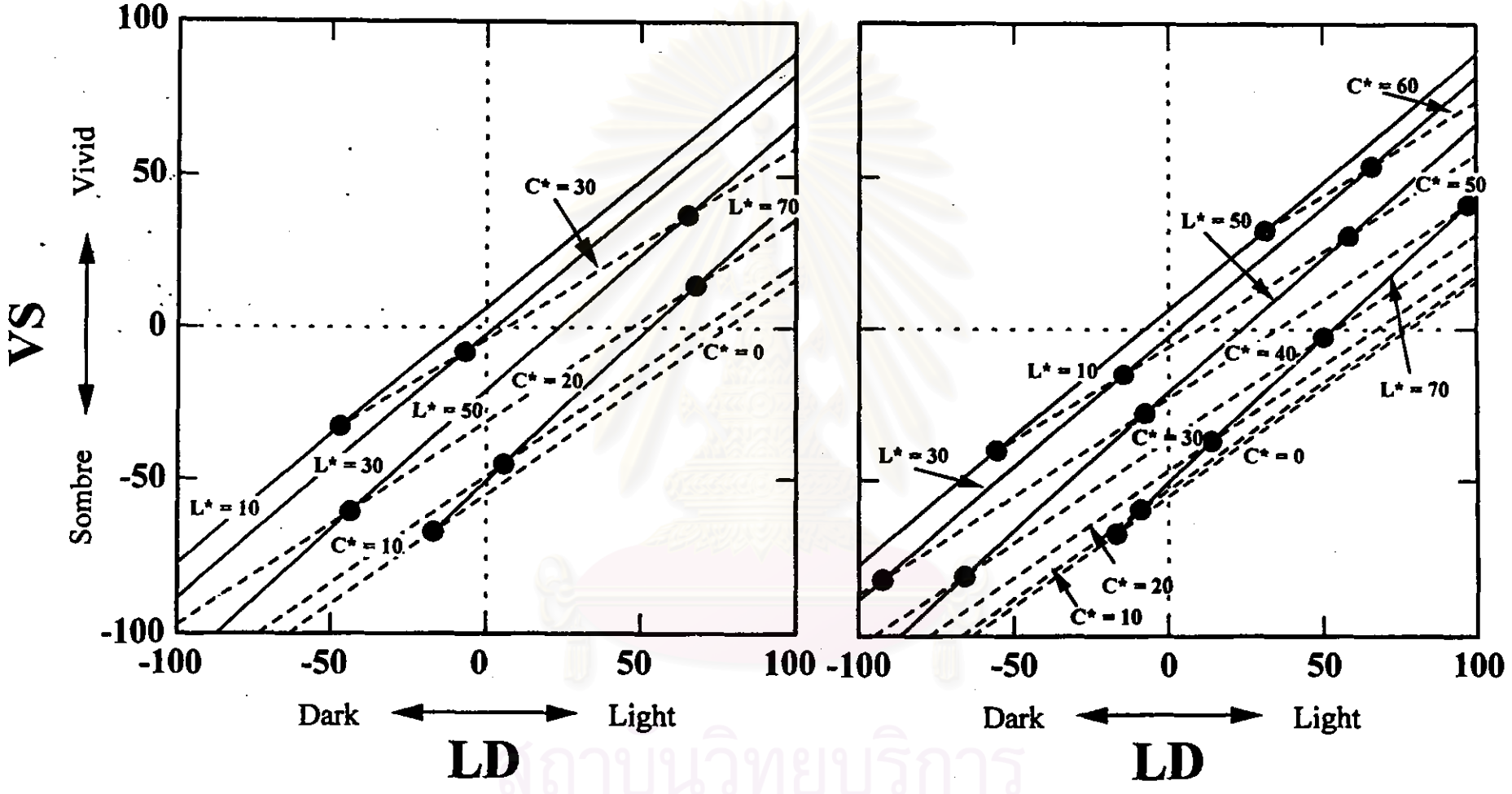


Figure 4-67 The projection of CIELAB color system on LD-VS color perception diagram: (a) h=270, (b) h=90

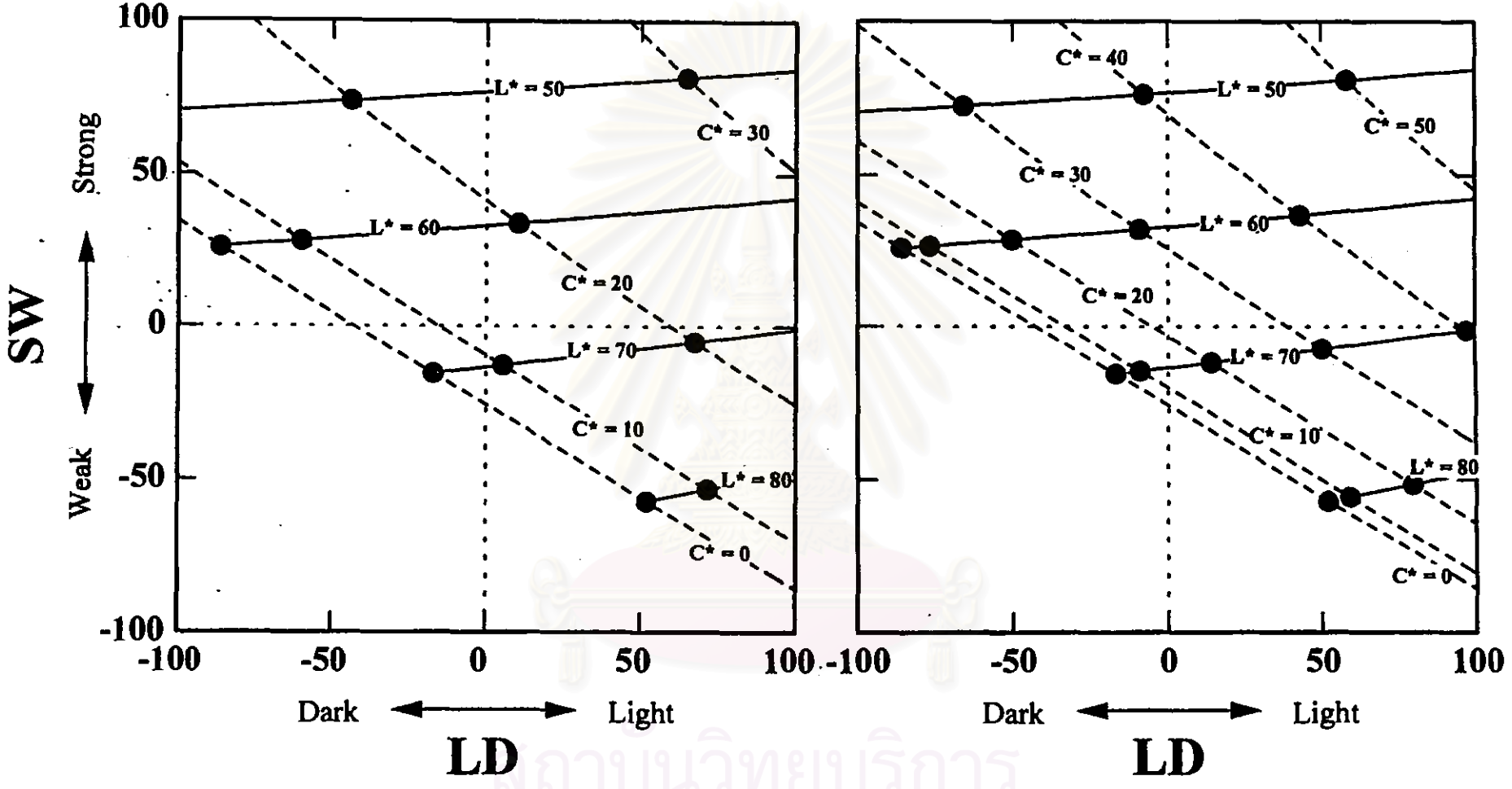
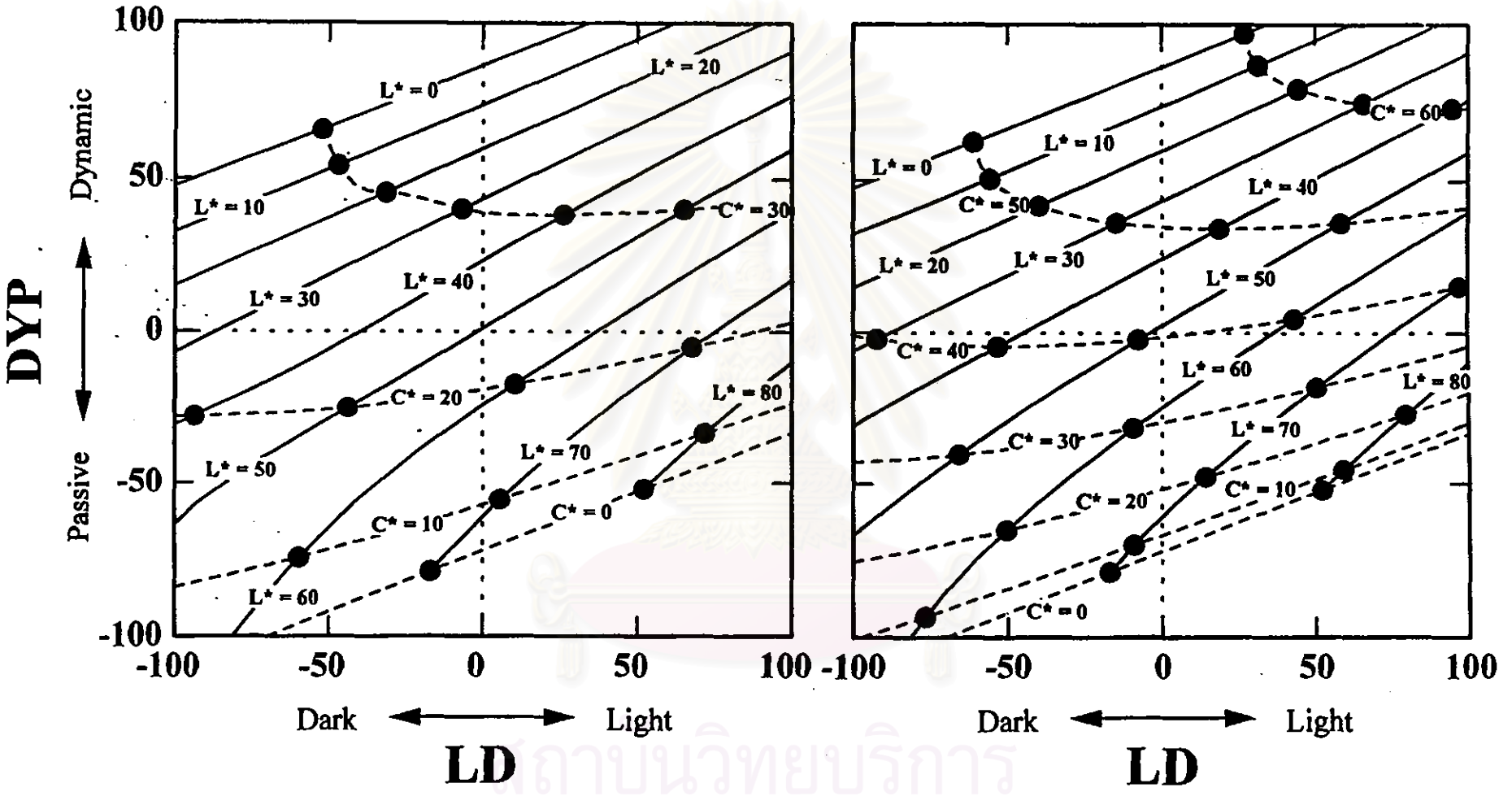


Figure 4-68 The projection of CIELAB color system on LD-SW color perception diagram: (a) h=270, (b) h=90



(a) h=270 (b) h=90

Figure 4-69 The projection of CIELAB color system on LD-DYP color perception diagram: (a) h=270, (b) h=90

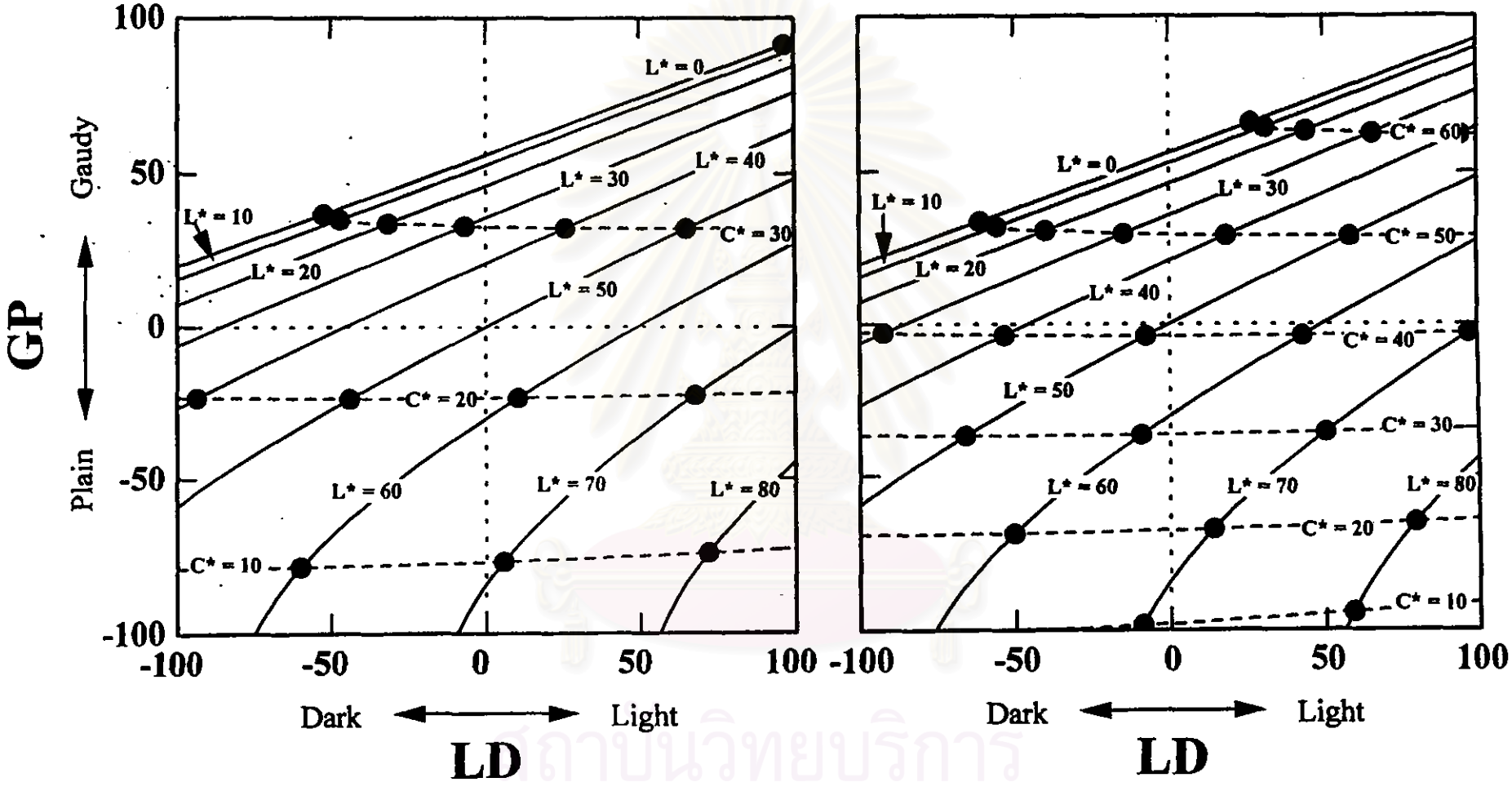
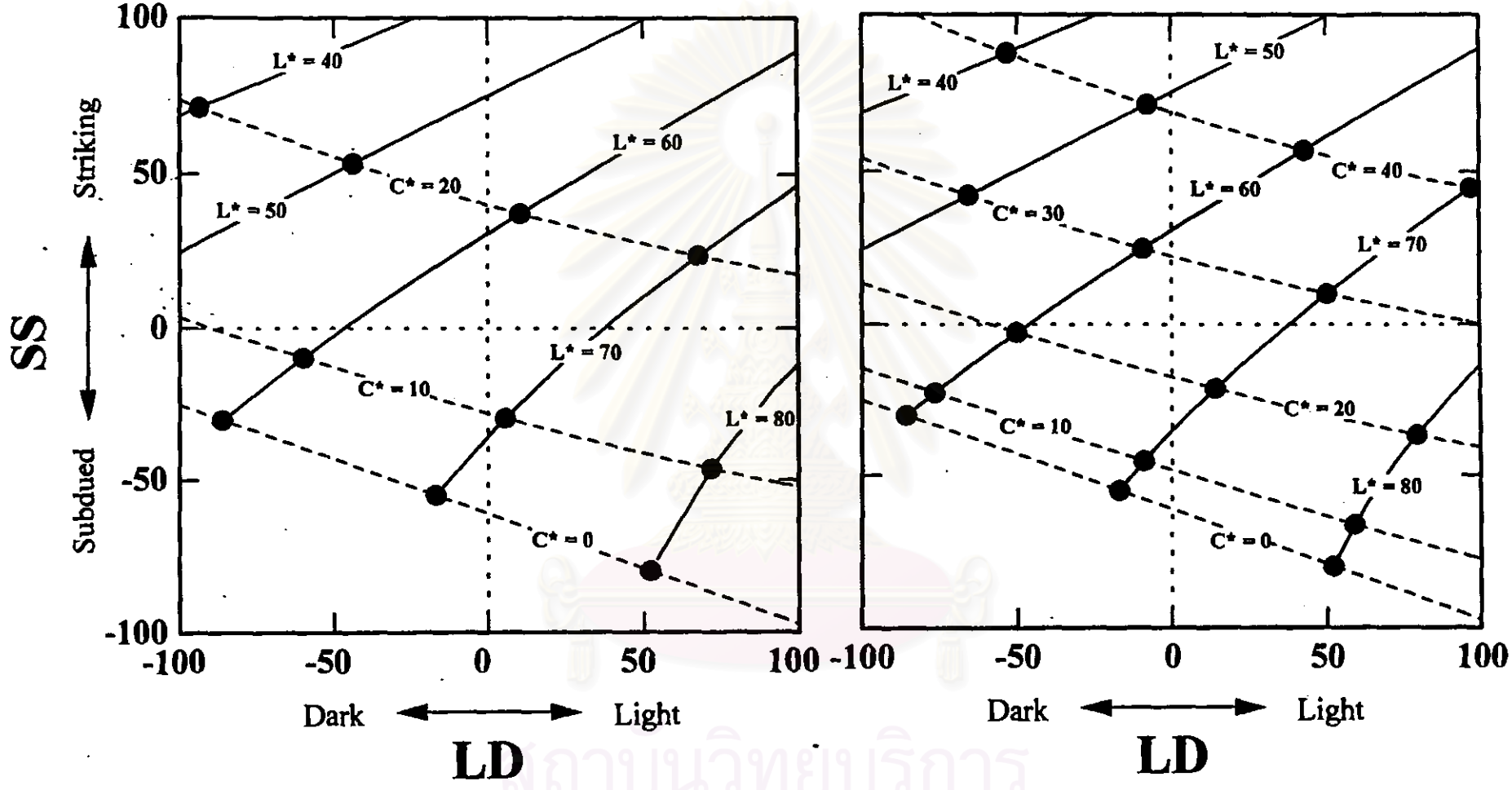


Figure 4-70 The projection of CIELAB color system on LD-GP color perception diagram: (a) h=270, (b) h=90



(a) h=270 (b) h=90

Figure 4-71 The projection of CIELAB color system on LD-SS color perception diagram: (a) h=270, (b) h=90

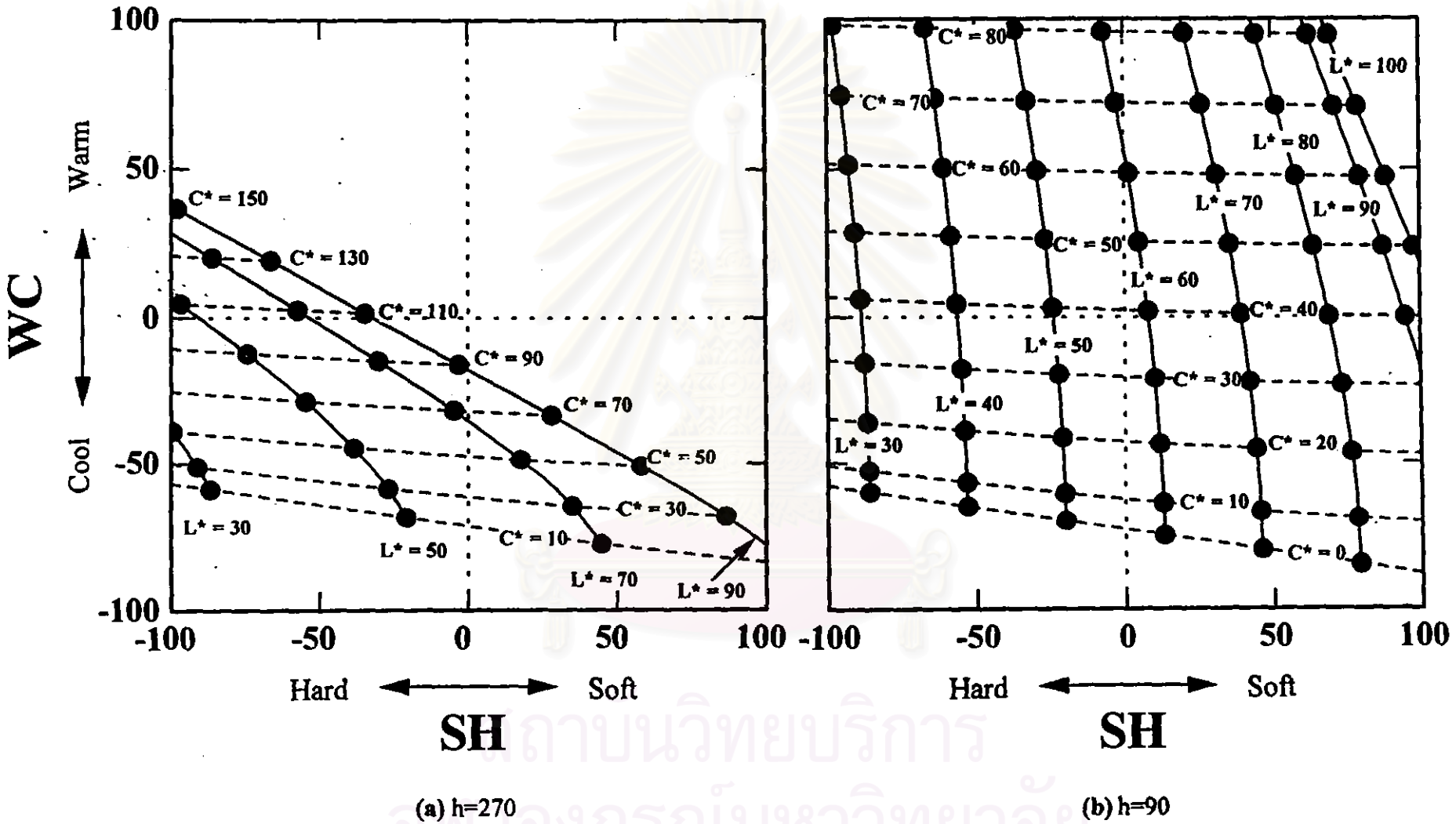
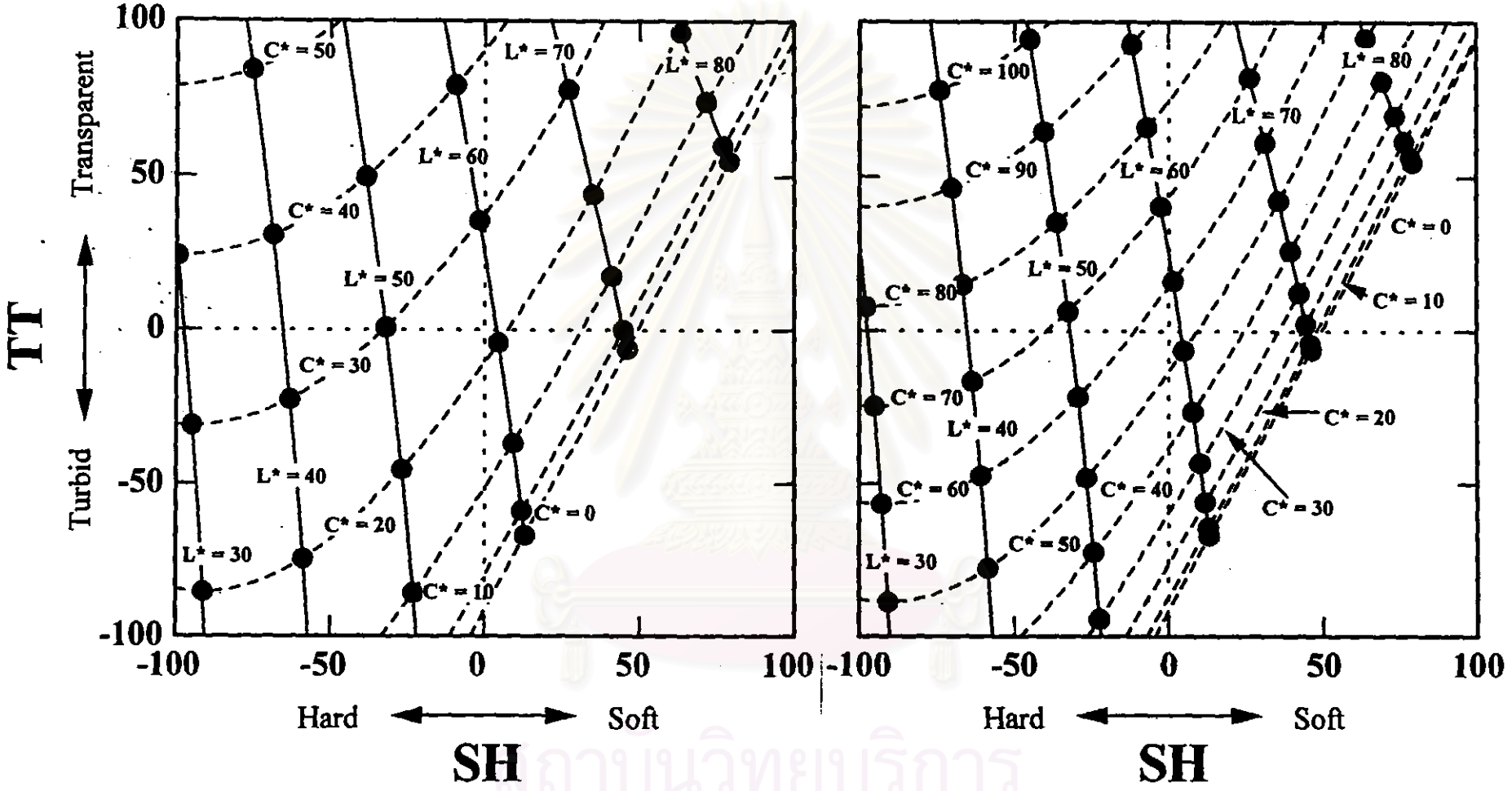


Figure 4-72 The projection of CIELAB color system on SH-WC color perception diagram: (a) h=270, (b) h=90



(a) h=270 (b) h=90

Figure 4-73 The projection of CIELAB color system on SH-TT color perception diagram: (a) h=270, (b) h=90

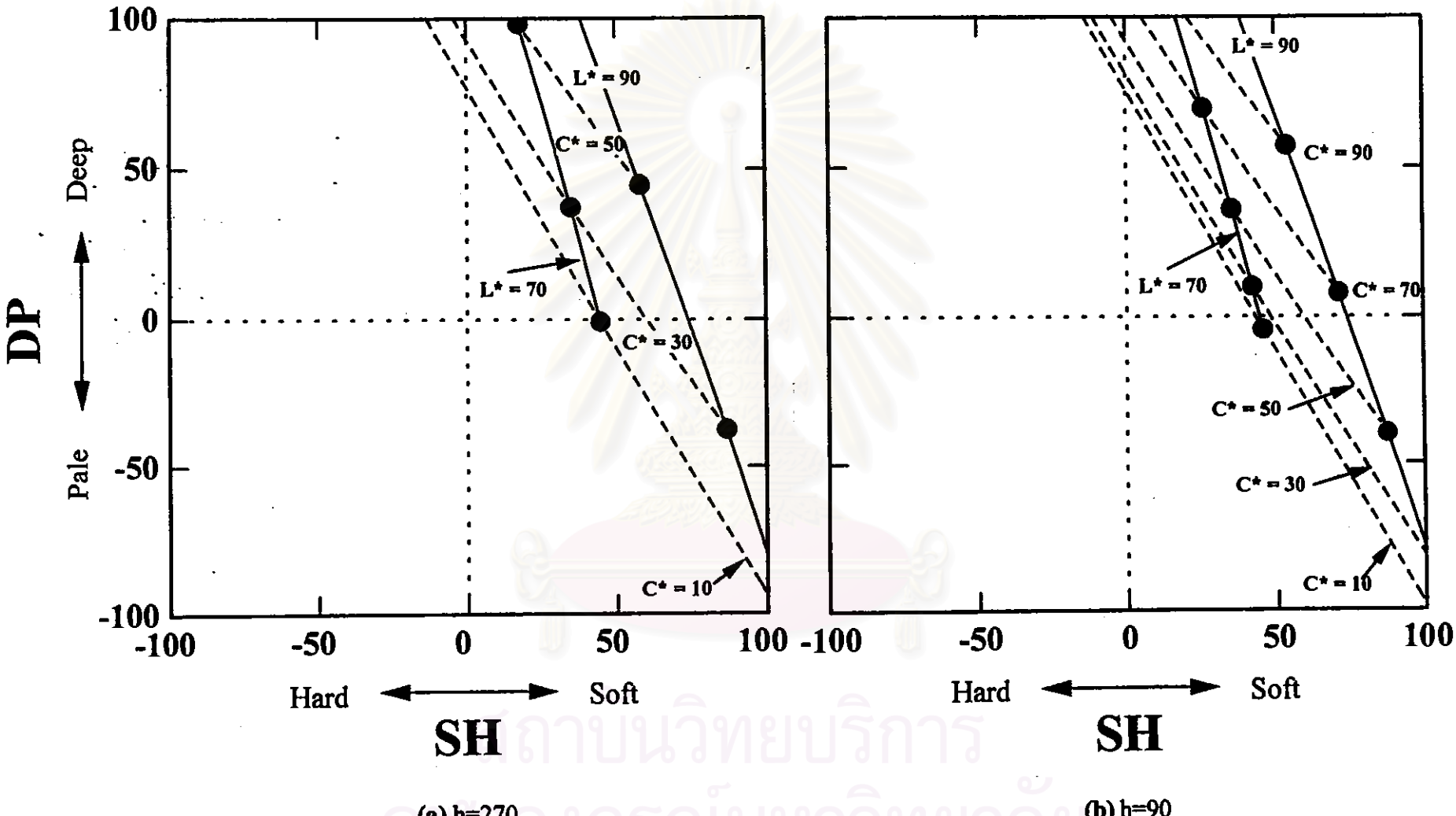


Figure 4-74 The projection of CIELAB color system on SH-DP color perception diagram: (a) h=270, (b) h=90

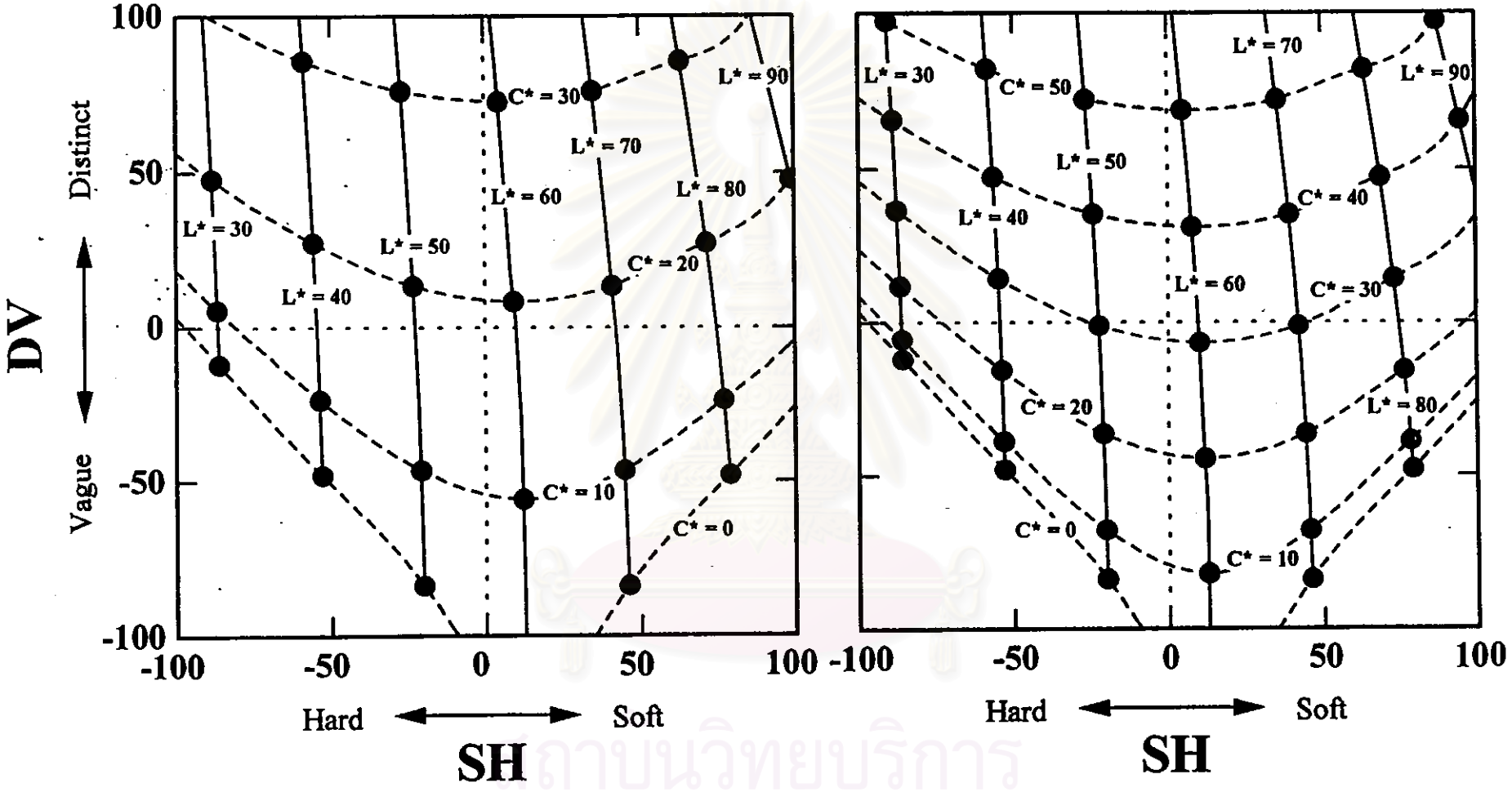


Figure 4-75 The projection of CIELAB color system on SH-DV color perception diagram: (a) h=270, (b) h=90

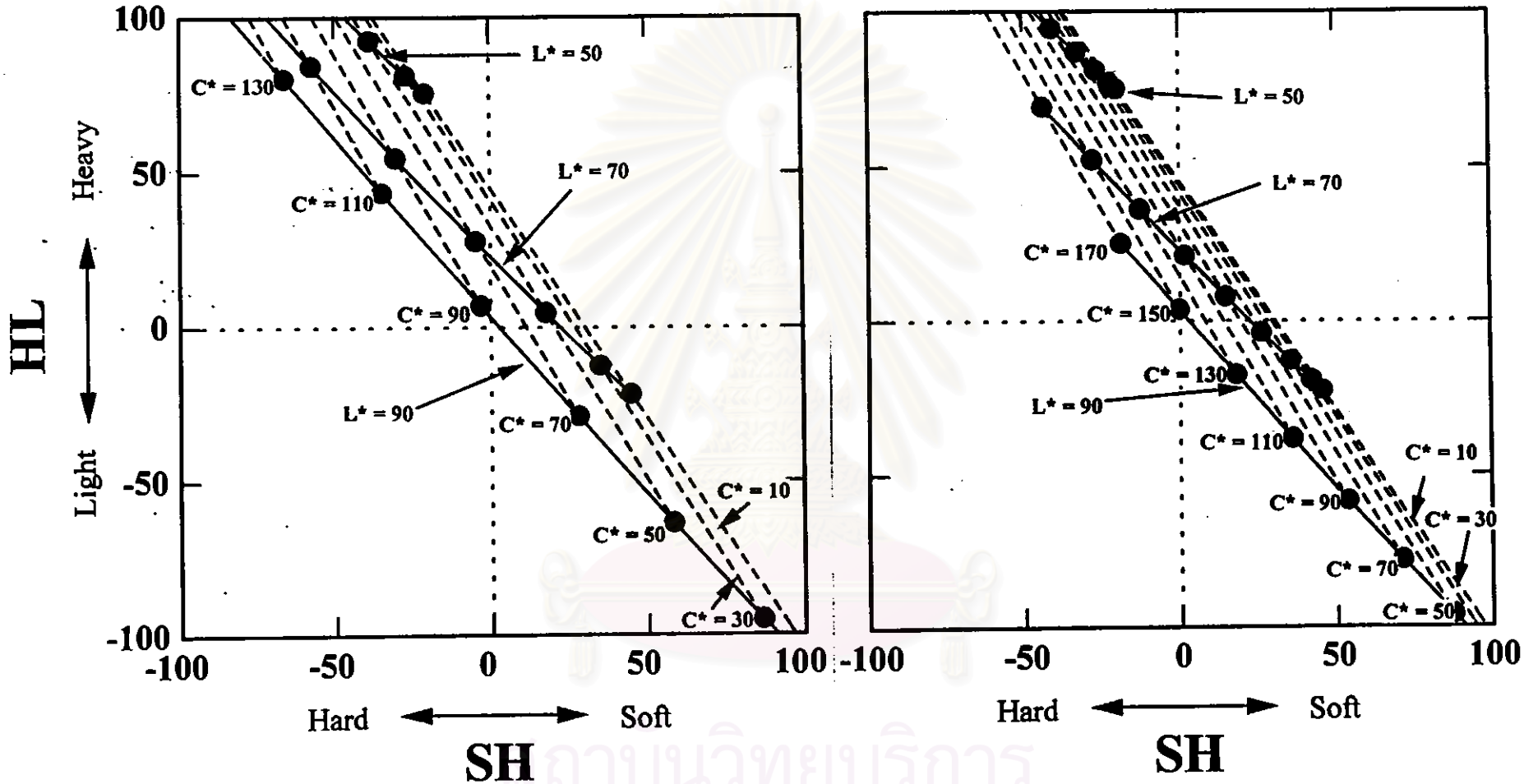


Figure 4-76 The projection of CIELAB color system on SH-HL color perception diagram: (a) h=270, (b) h=90

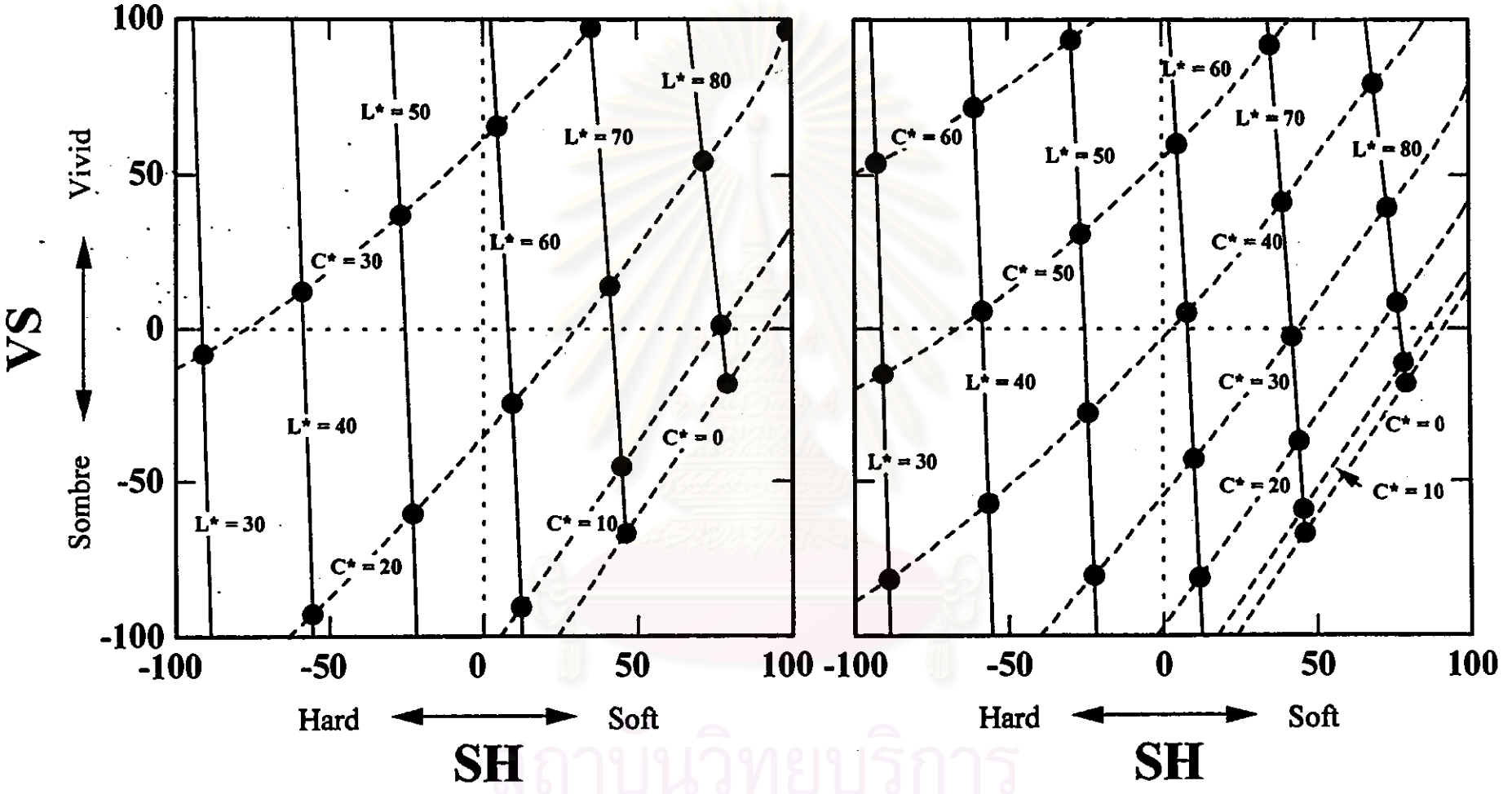


Figure 4-77 The projection of CIELAB color system on SH-VS color perception diagram: (a) h=270, (b) h=90

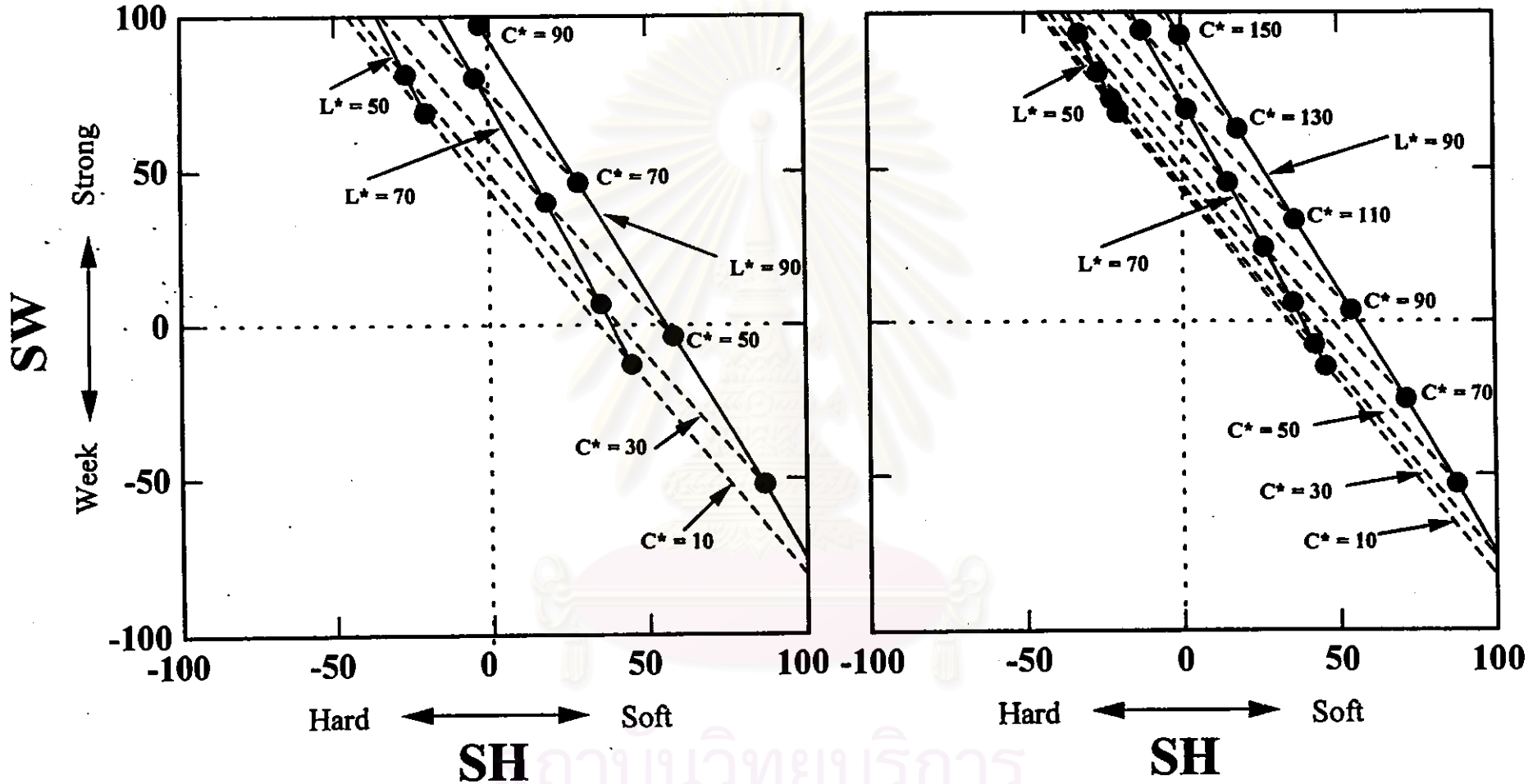


Figure 4-78 The projection of CIELAB color system on SH-SW color perception diagram: (a) h=270, (b) h=90

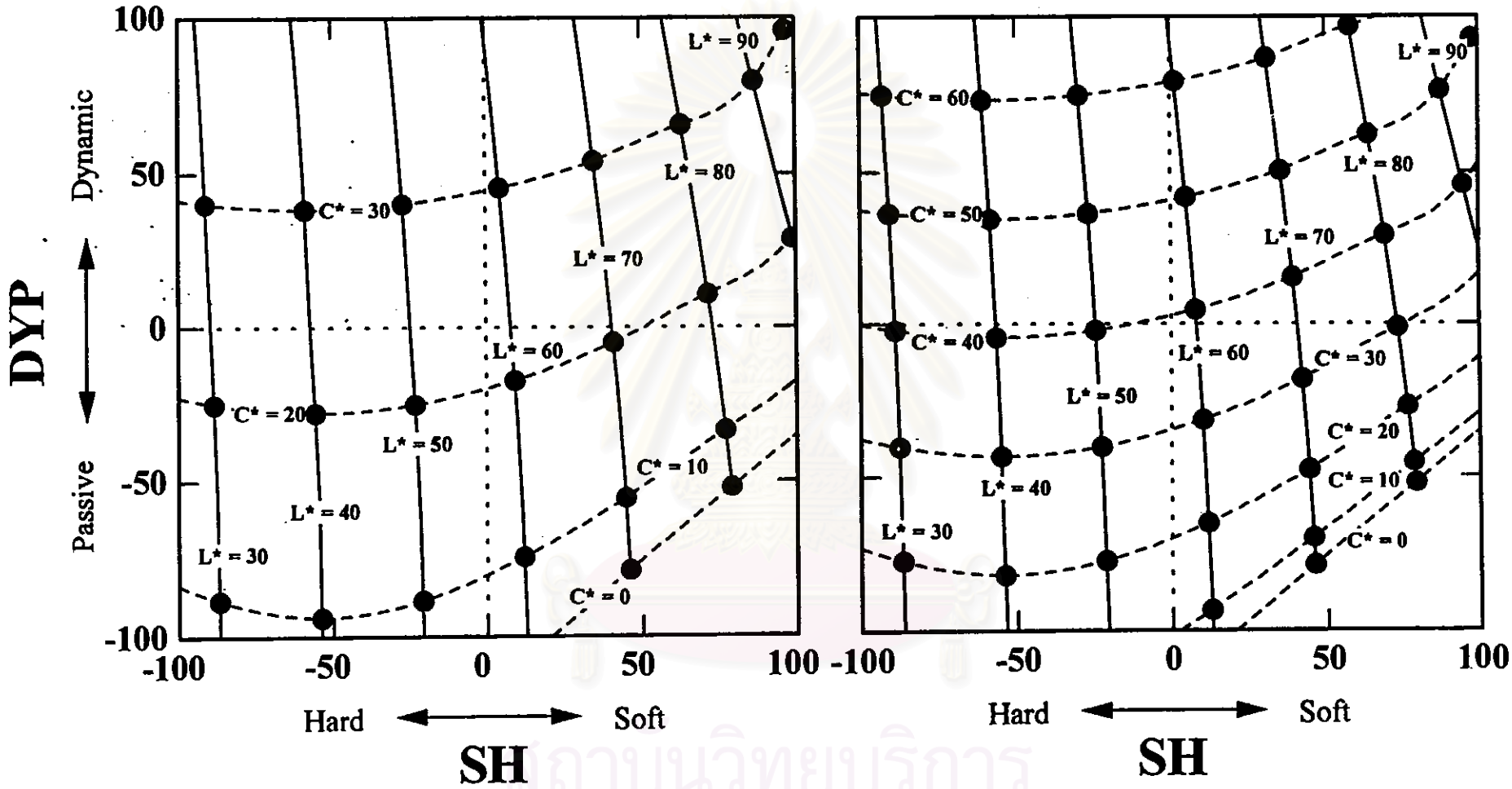


Figure 4-79 The projection of CIELAB color system on SH-DYP color perception diagram: (a) h=270, (b) h=90

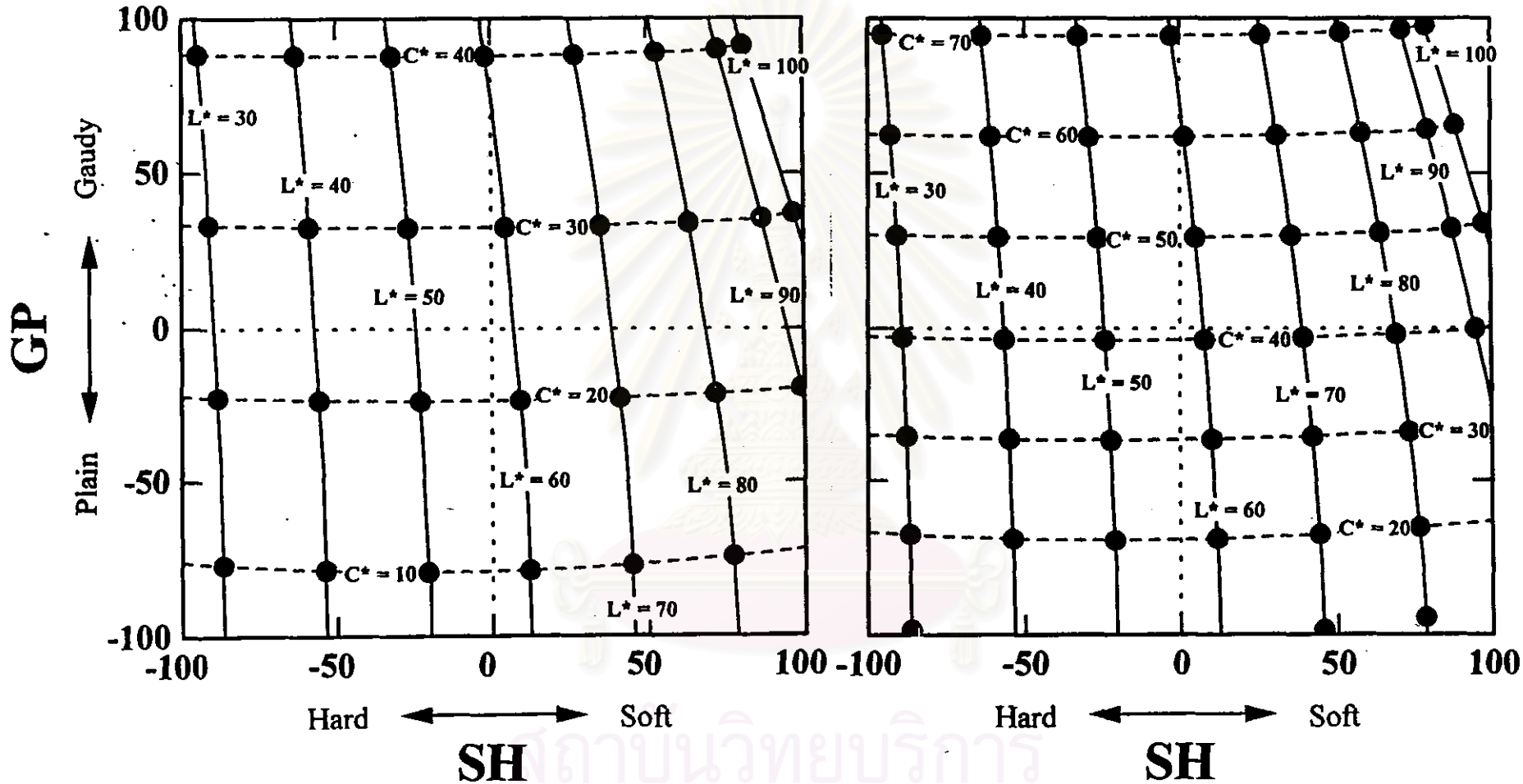


Figure 4-80 The projection of CIELAB color system on SH-GP color perception diagram: (a) h=270, (b) h=90

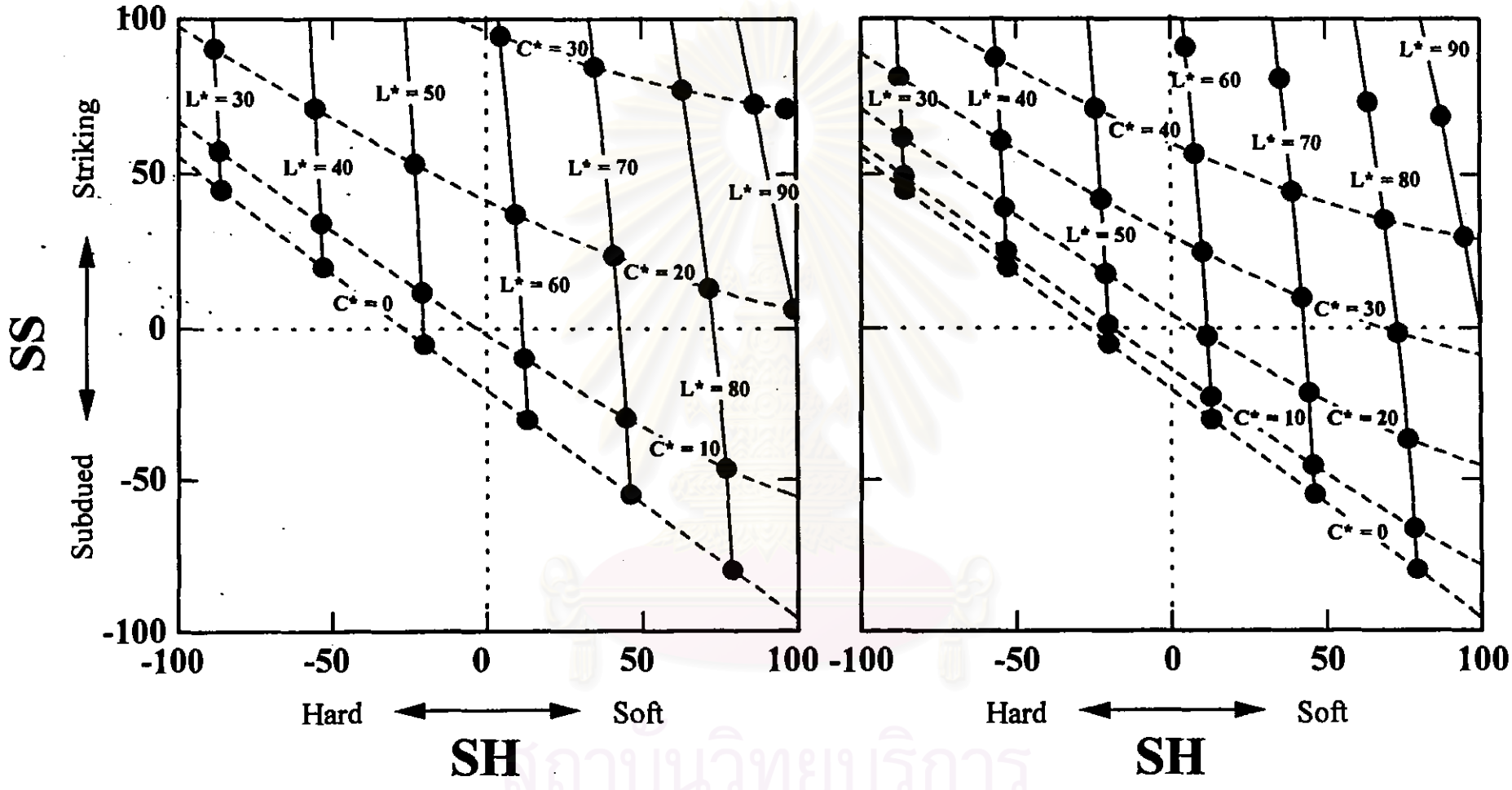


Figure 4-81 The projection of CIELAB color system on SH-SS color perception diagram: (a) h=270, (b) h=90

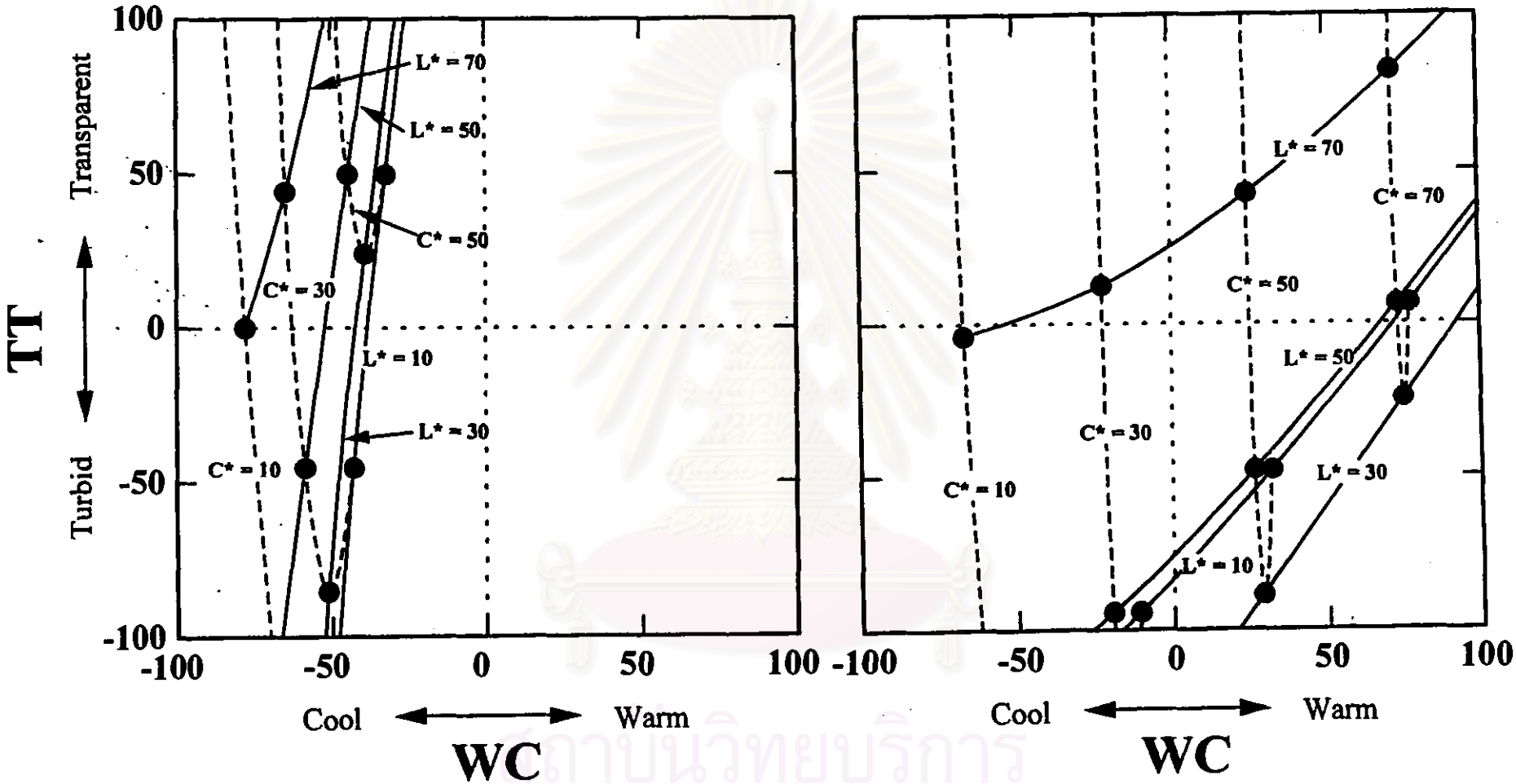


Figure 4-82 The projection of CIELAB color system on WC-TT color perception diagram: (a) h=270, (b) h=90

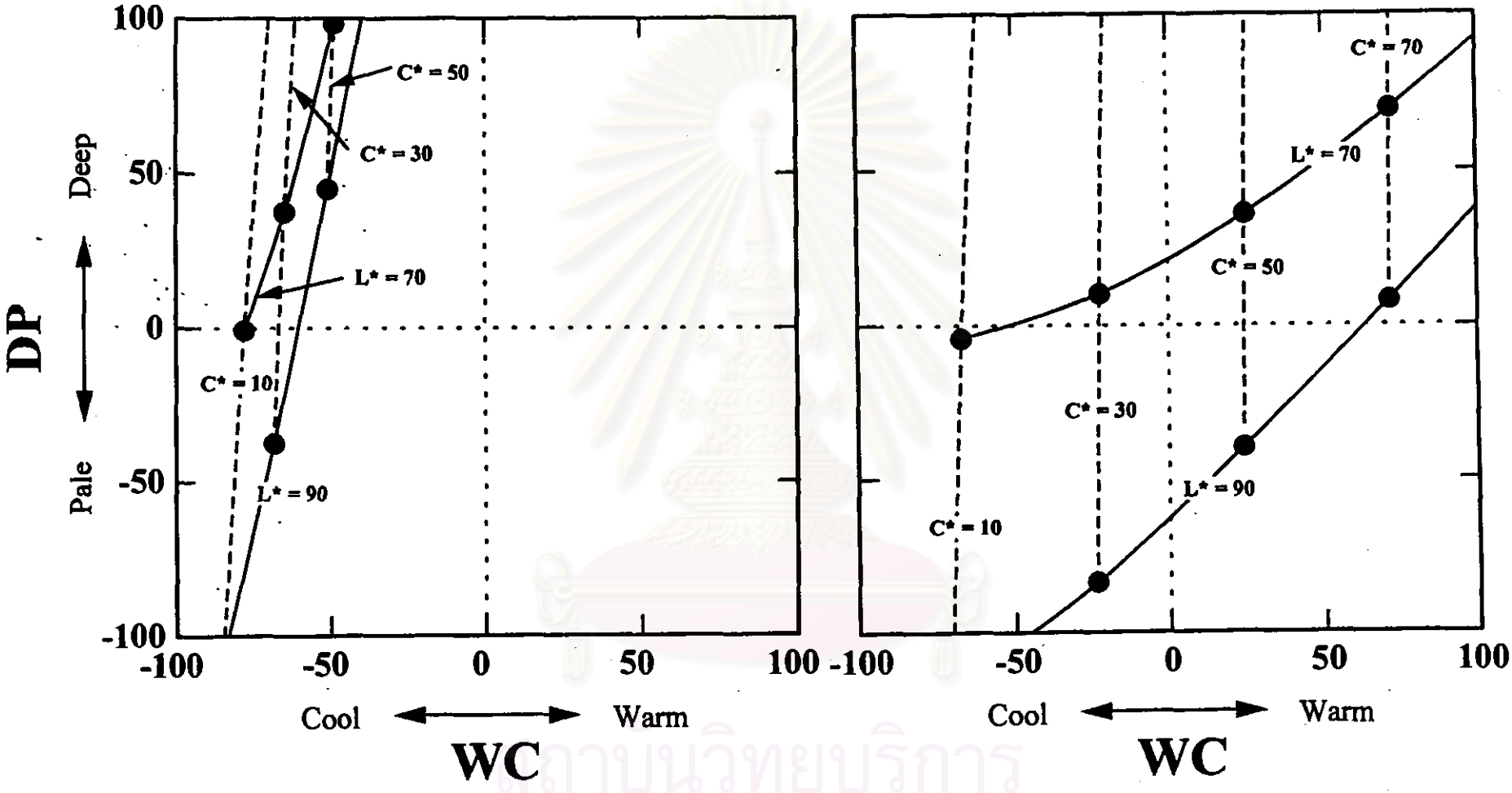


Figure 4-83 The projection of CIELAB color system on WC-DP color perception diagram: (a) h=270, (b) h=90

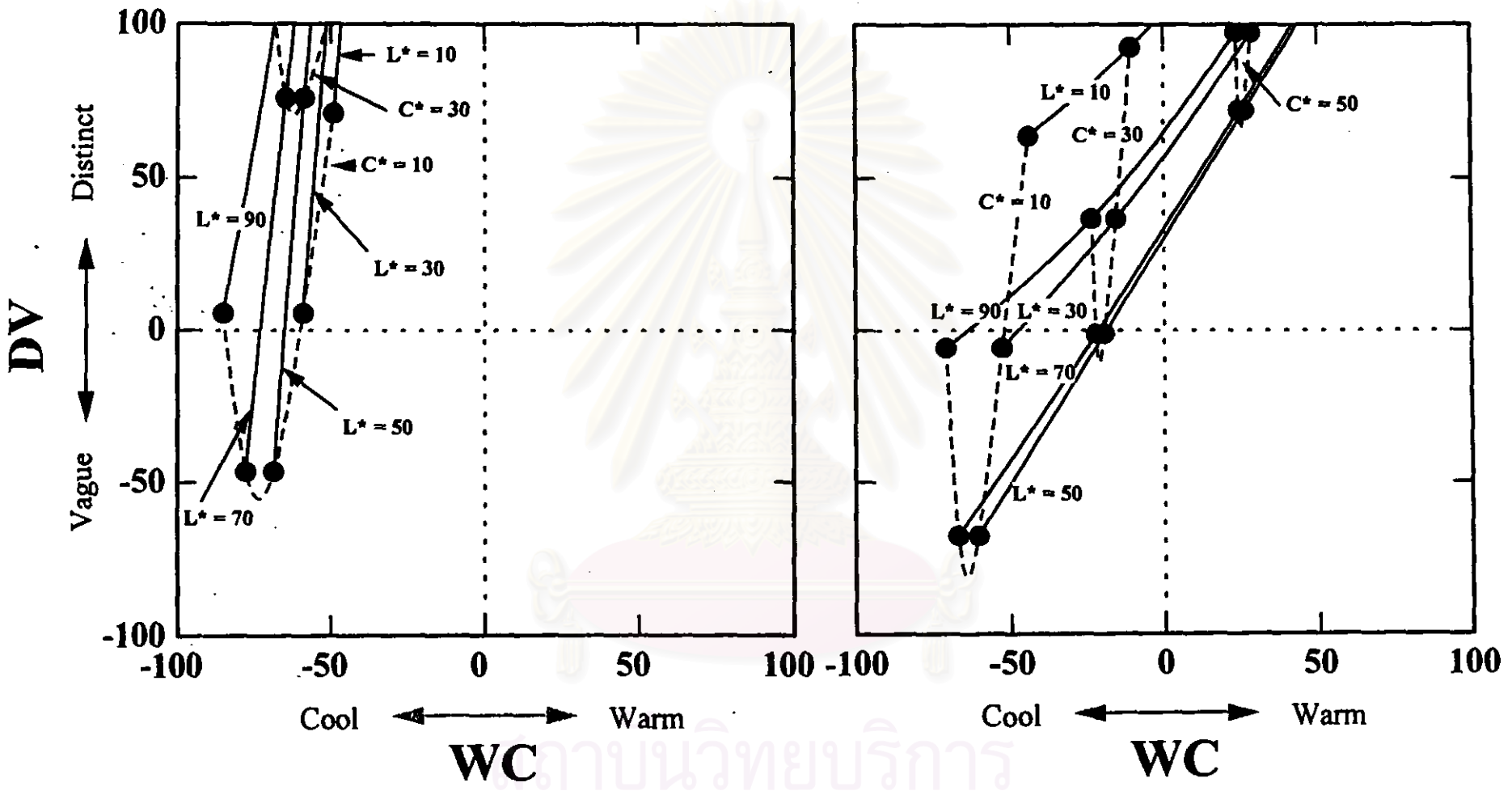


Figure 4-84 The projection of CIELAB color system on WC-DV color perception diagram: (a) h=270, (b) h=90

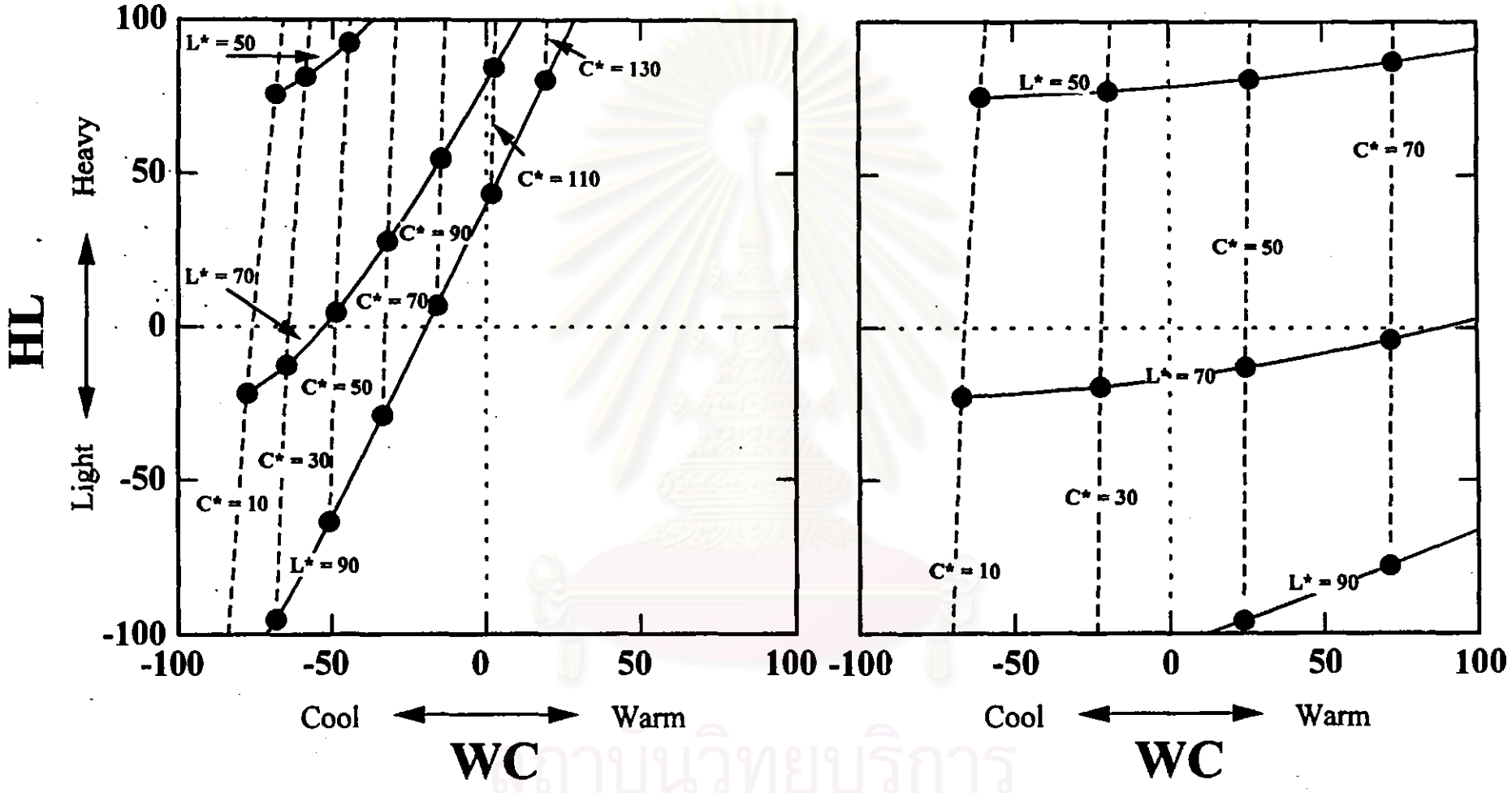
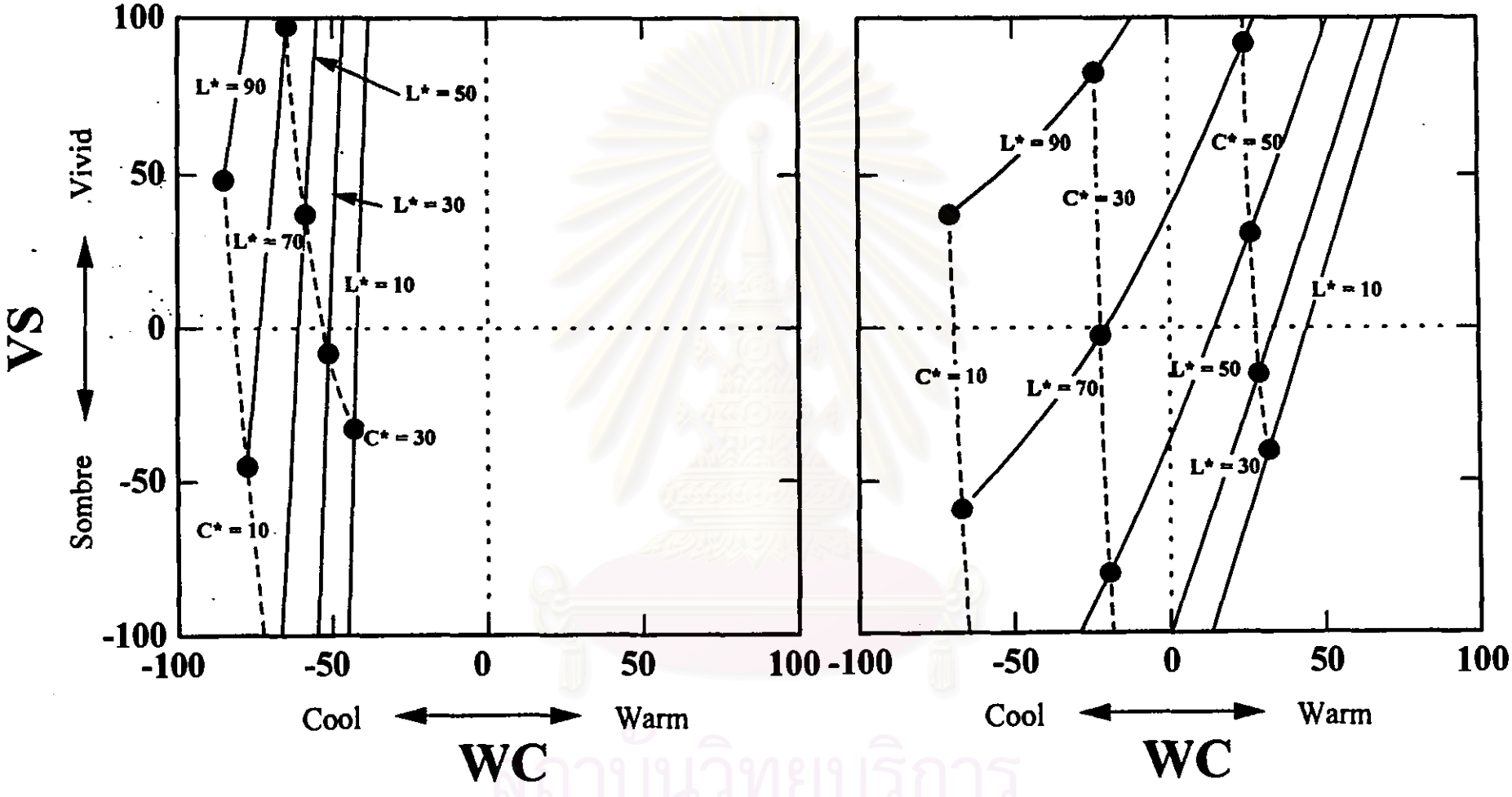


Figure 4-85 The projection of CIELAB color system on WC-HL color perception diagram: (a) h=270, (b) h=90



(a) h=270 (b) h=90

Figure 4-86 The projection of CIELAB color system on WC-VS color perception diagram: (a) h=270, (b) h=90

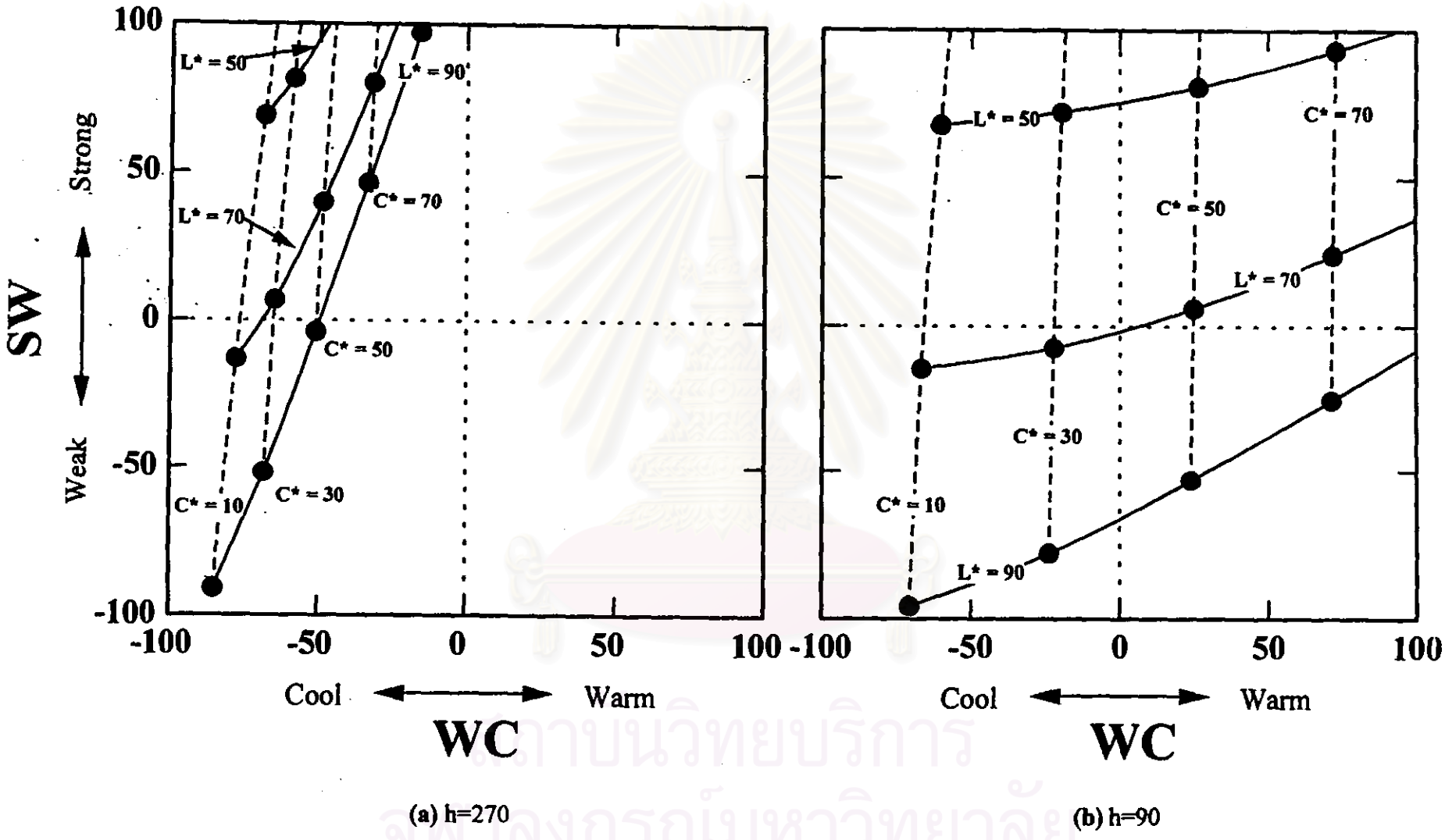


Figure 4-87 The projection of CIELAB color system on WC-SW color perception diagram: (a) h=270, (b) h=90

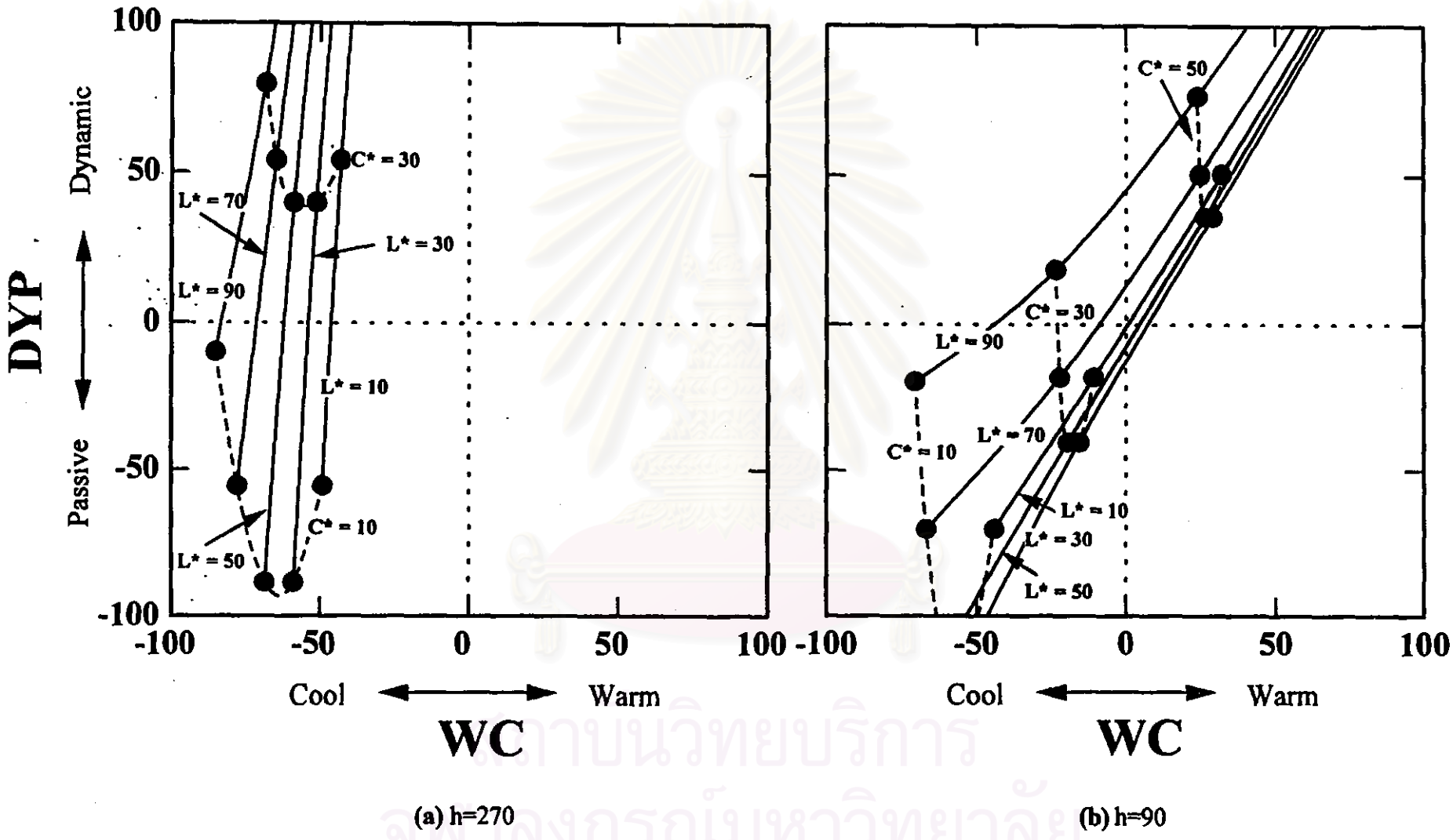
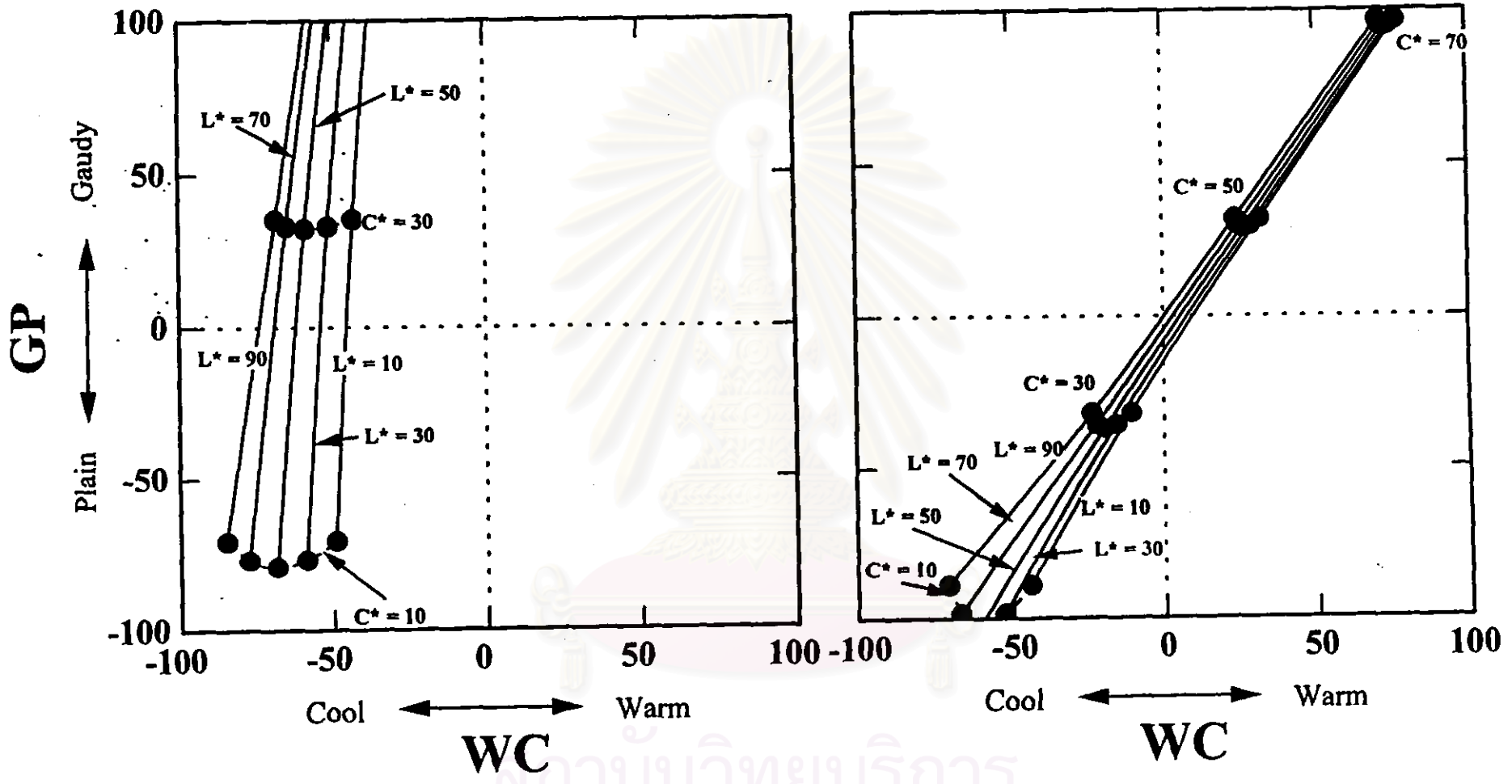


Figure 4-88 The projection of CIELAB color system on WC-DYP color perception diagram: (a) h=270, (b) h=90



(a) h=270

(b) h=90

Figure 4-89 The projection of CIELAB color system on WC-GP color perception diagram: (a) h=270, (b) h=90

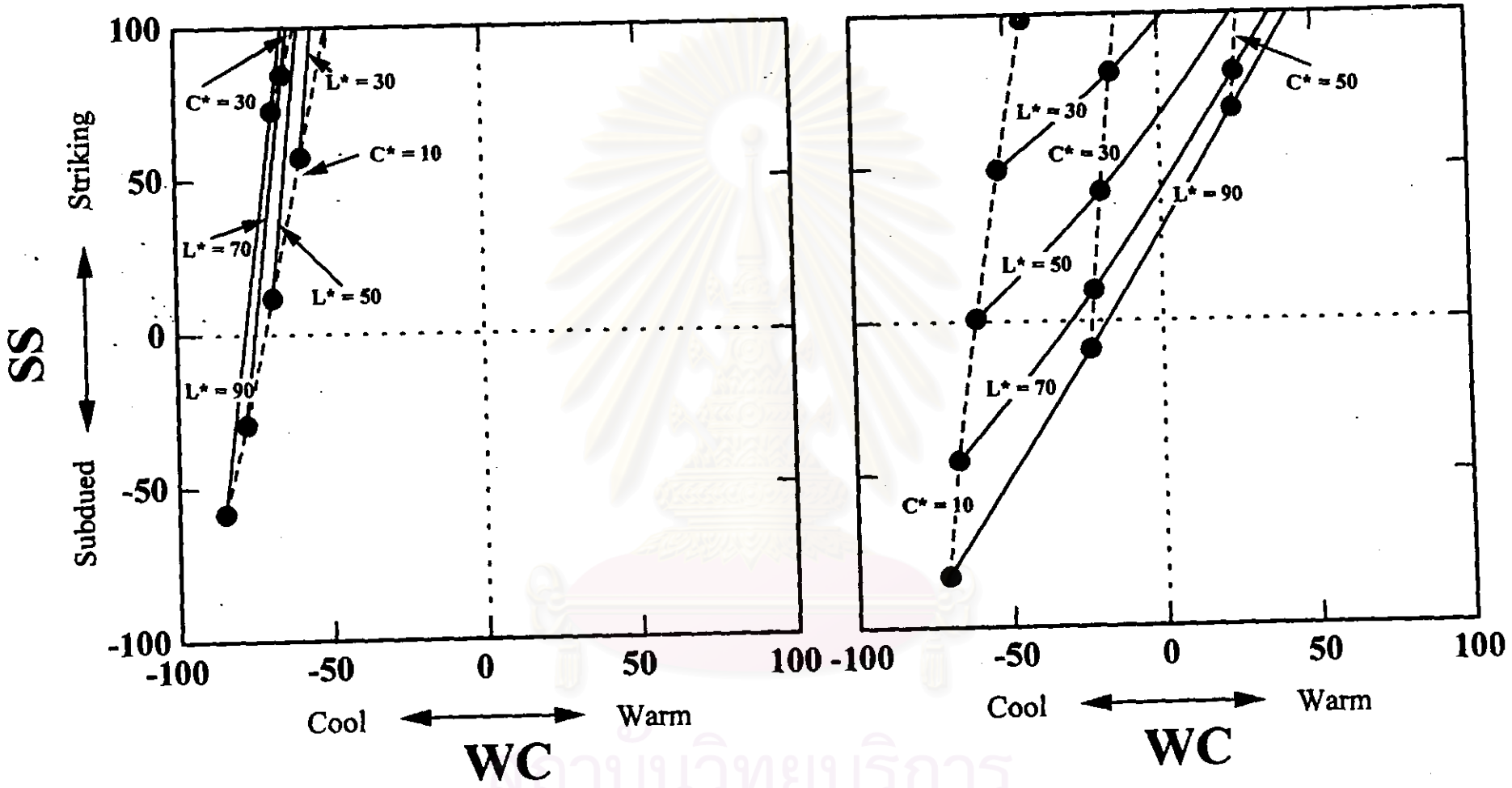


Figure 4-90 The projection of CIELAB color system on WC-SS color perception diagram: (a) h=270, (b) h=90

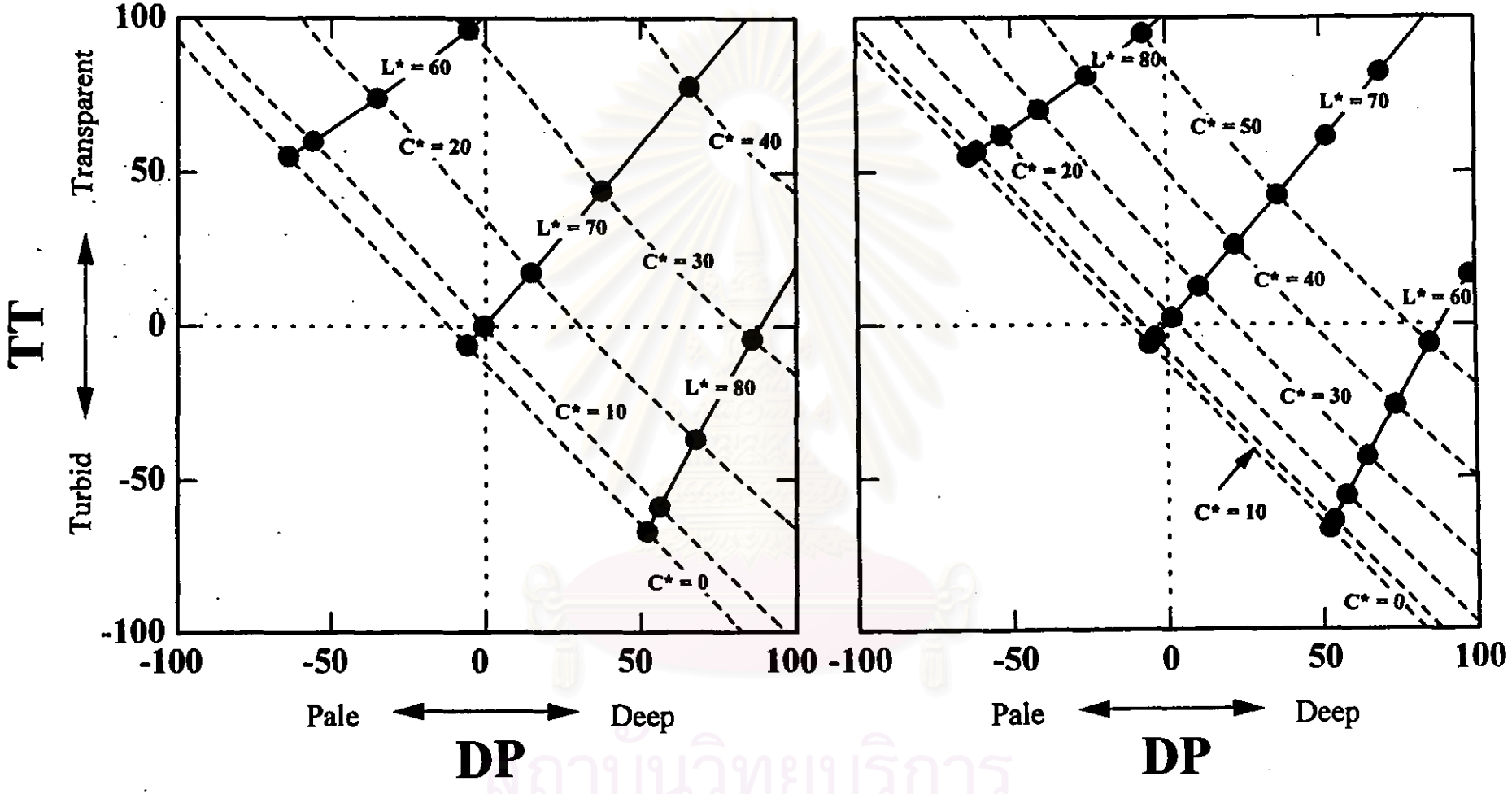


Figure 4-91 The projection of CIELAB color system on DP-TT color perception diagram: (a) h=270, (b) h=90

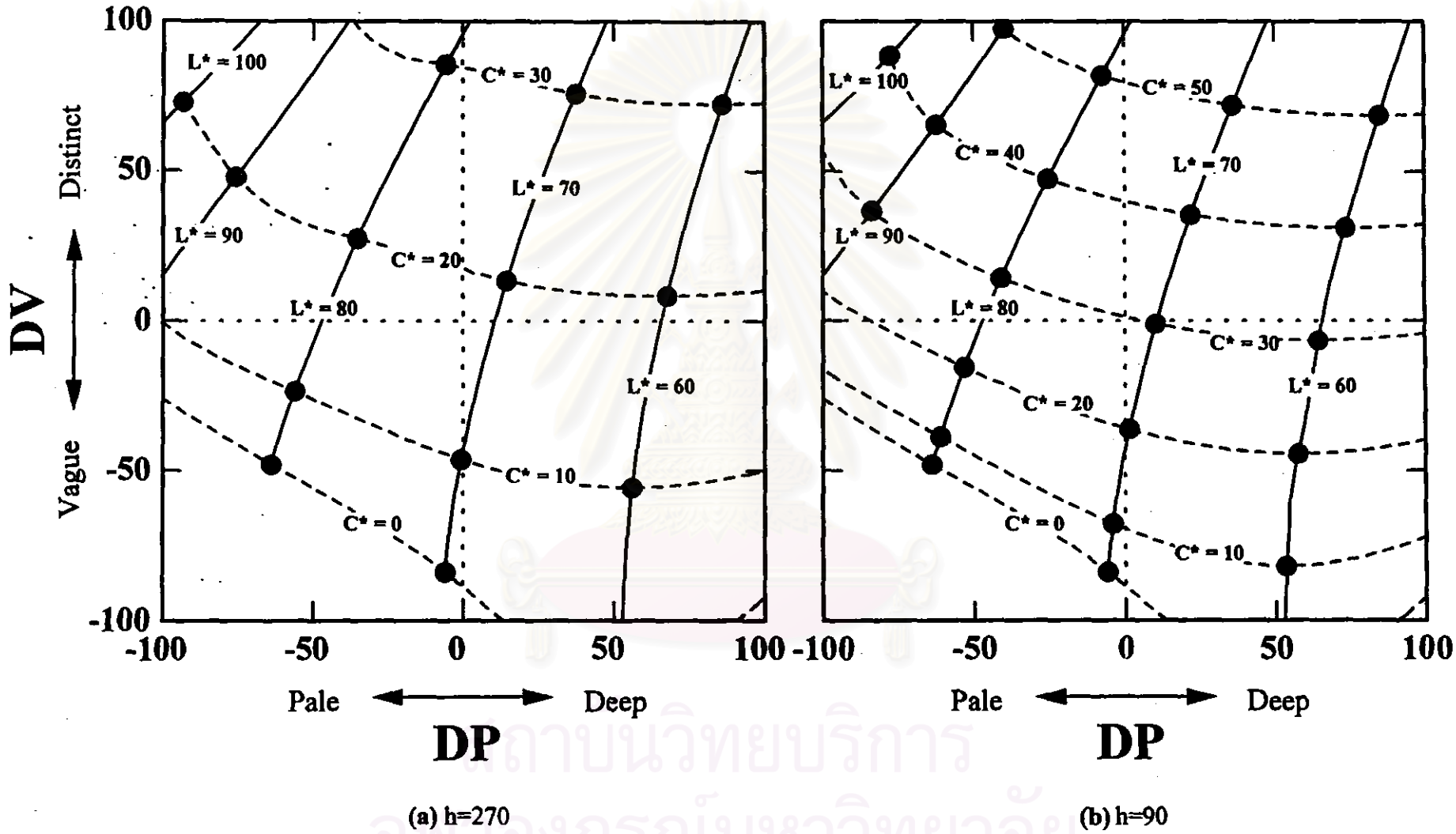


Figure 4-92 The projection of CIELAB color system on DP-DV color perception diagram: (a) h=270, (b) h=90

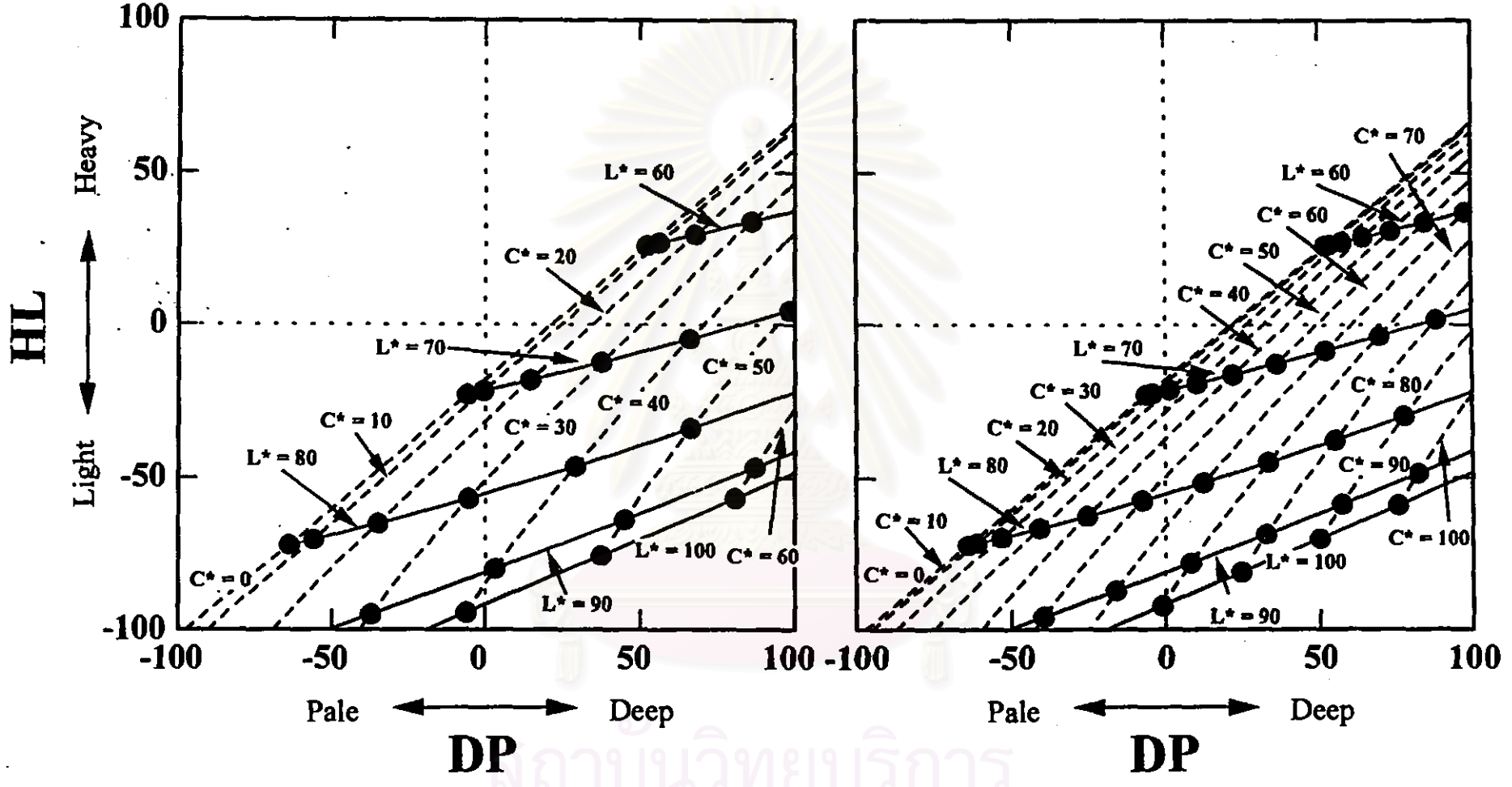


Figure 4-93 The projection of CIELAB color system on DP-HL color perception diagram: (a) h=270, (b) h=90

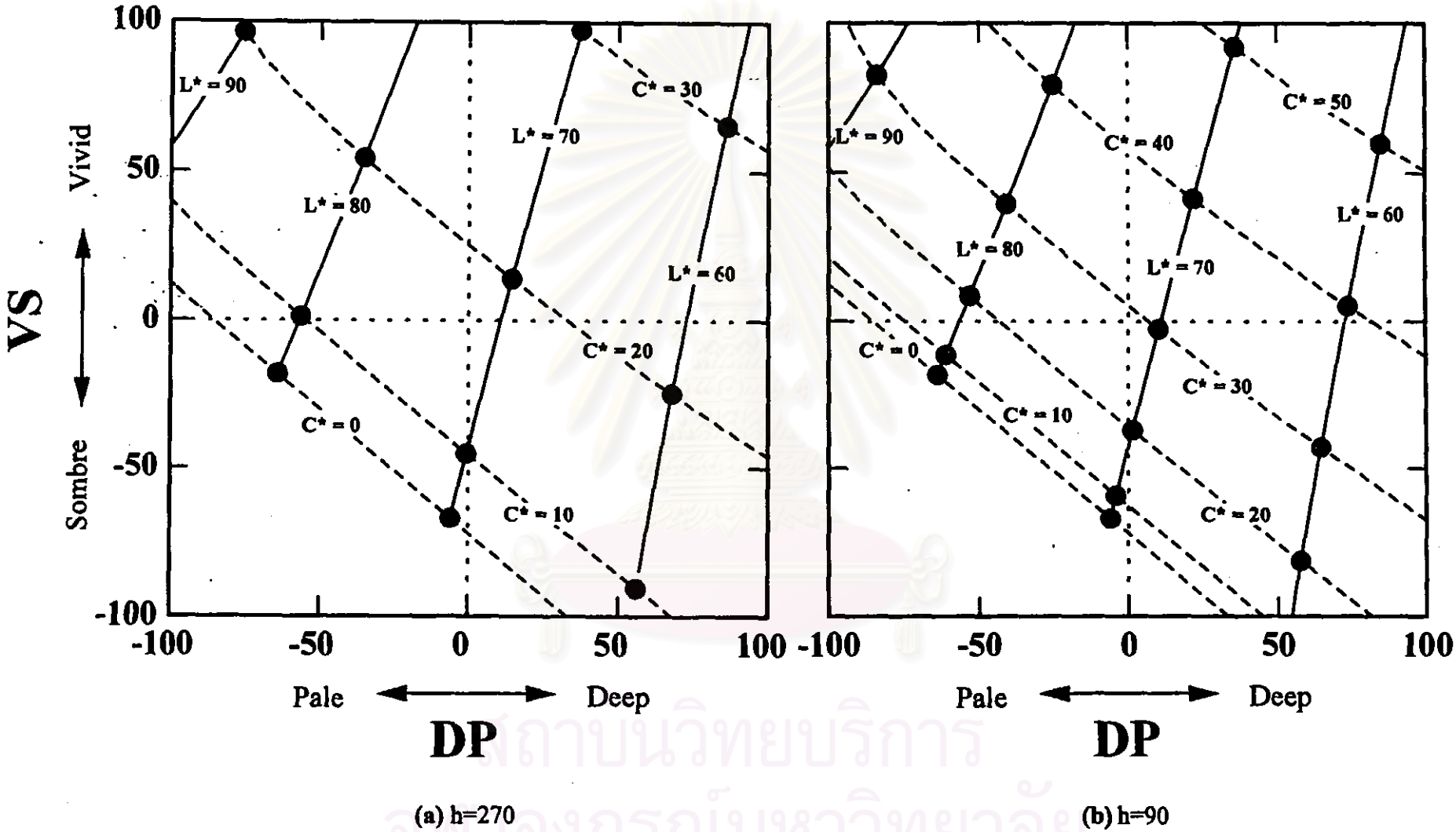


Figure 4-94 The projection of CIELAB color system on DP-VS color perception diagram: (a) h=270, (b) h=90

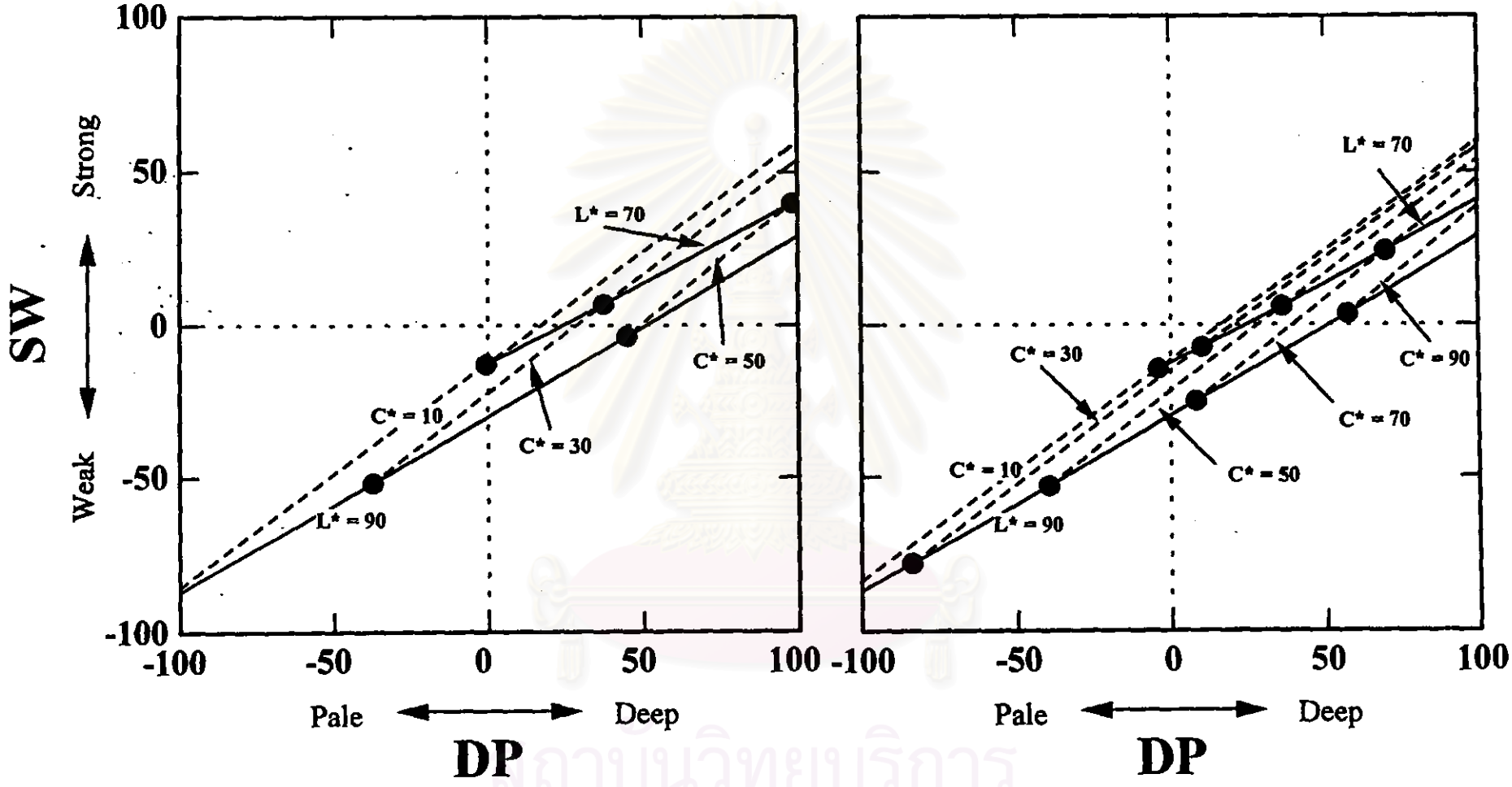


Figure 4-95 The projection of CIELAB color system on DP-SW color perception diagram: (a) h=270, (b) h=90

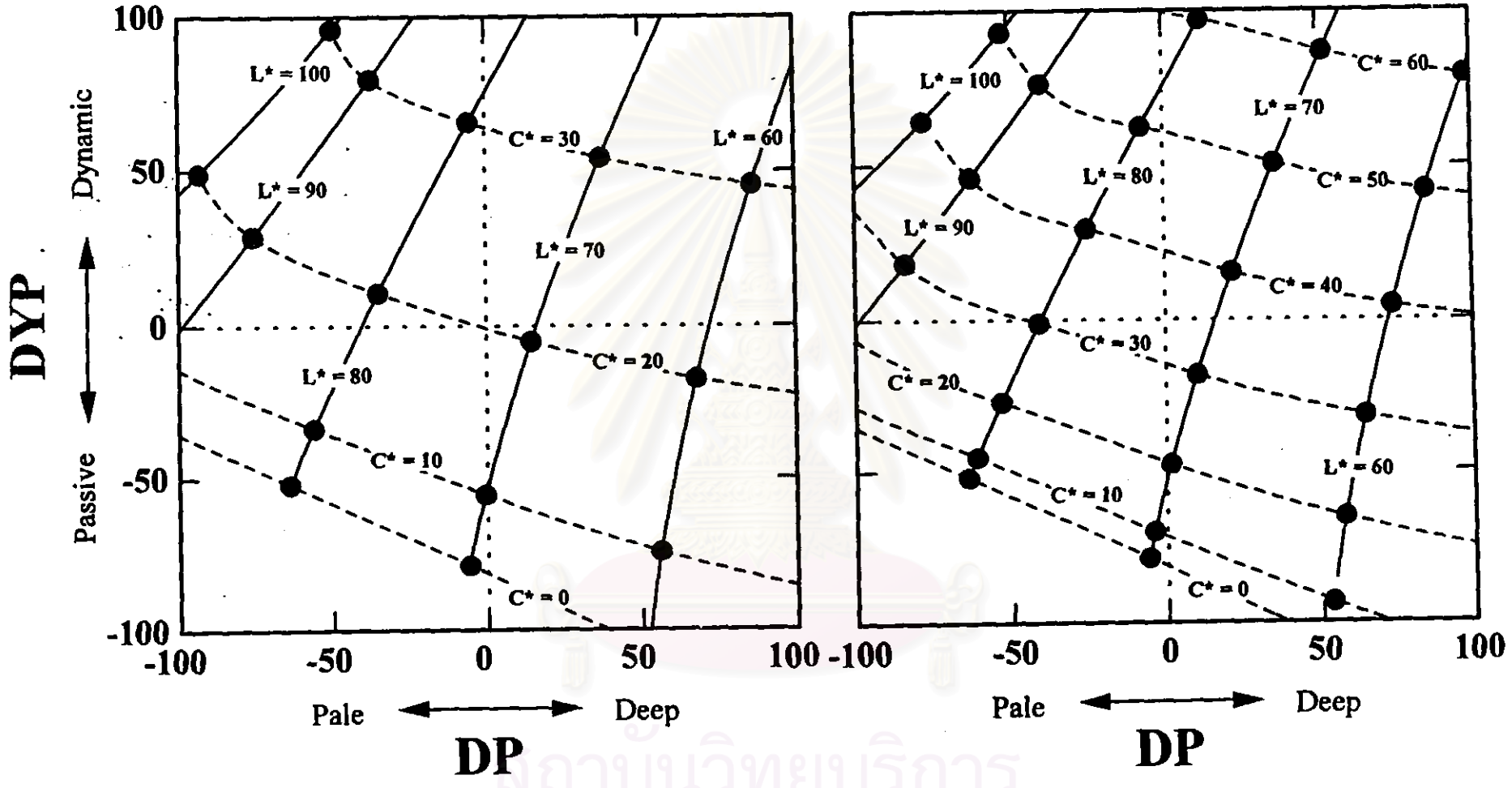


Figure 4-96 The projection of CIELAB color system on DP-DYP color perception diagram: (a) h=270, (b) h=90

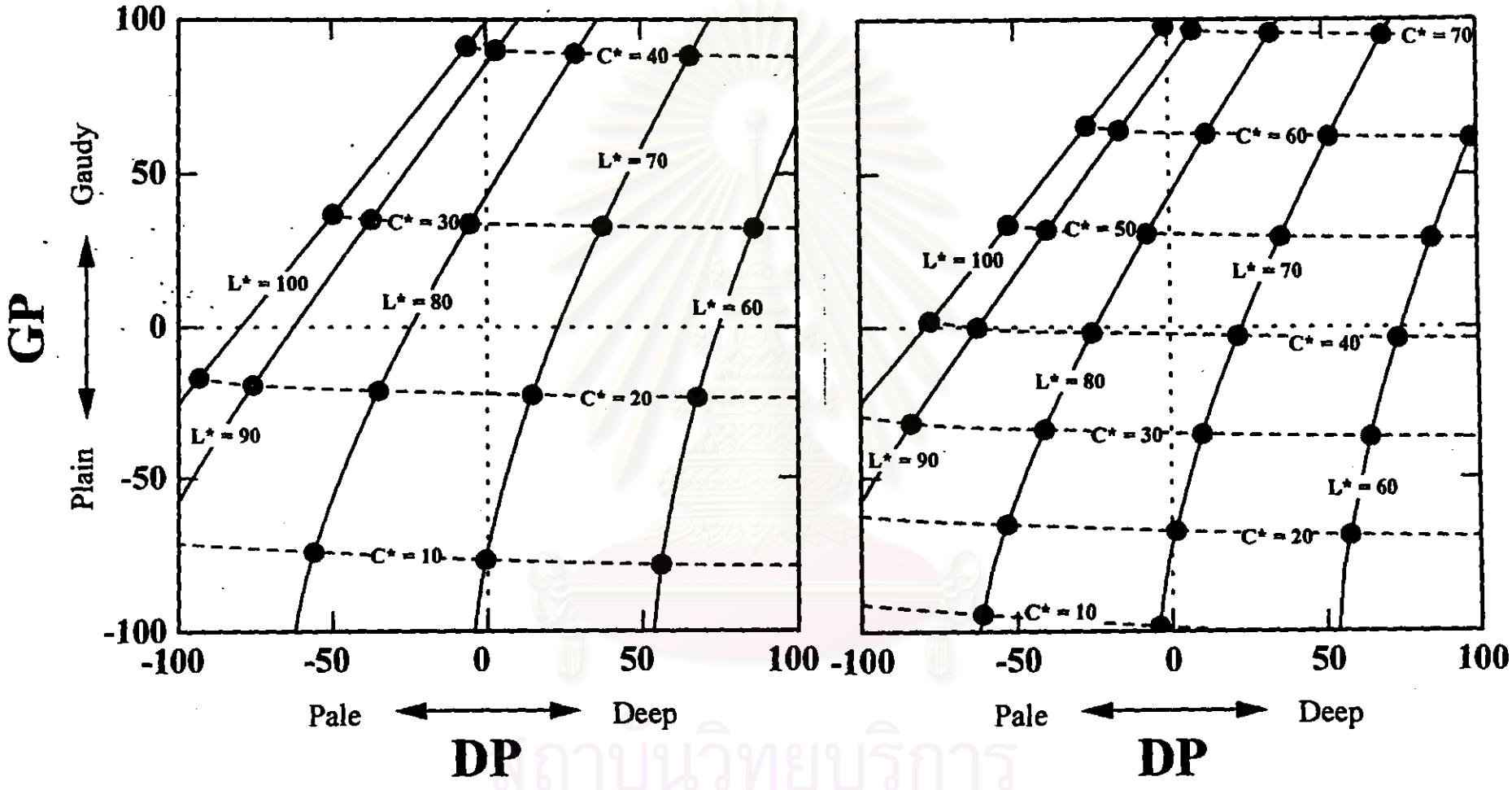


Figure 4-97 The projection of CIELAB color system on DP-GP color perception diagram: (a) h=270, (b) h=90

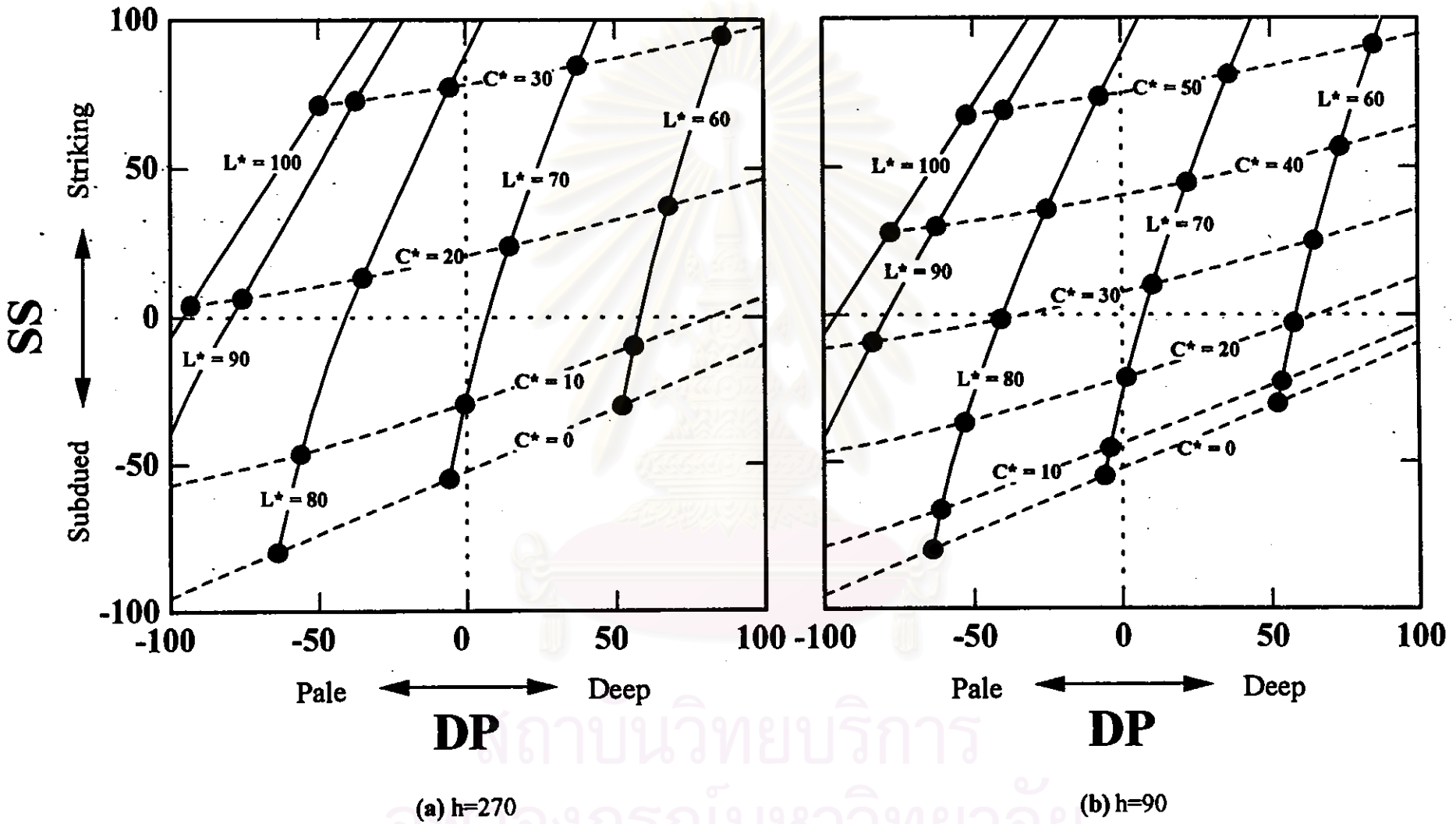


Figure 4-98 The projection of CIELAB color system on DP-SS color perception diagram: (a) h=270, (b) h=90

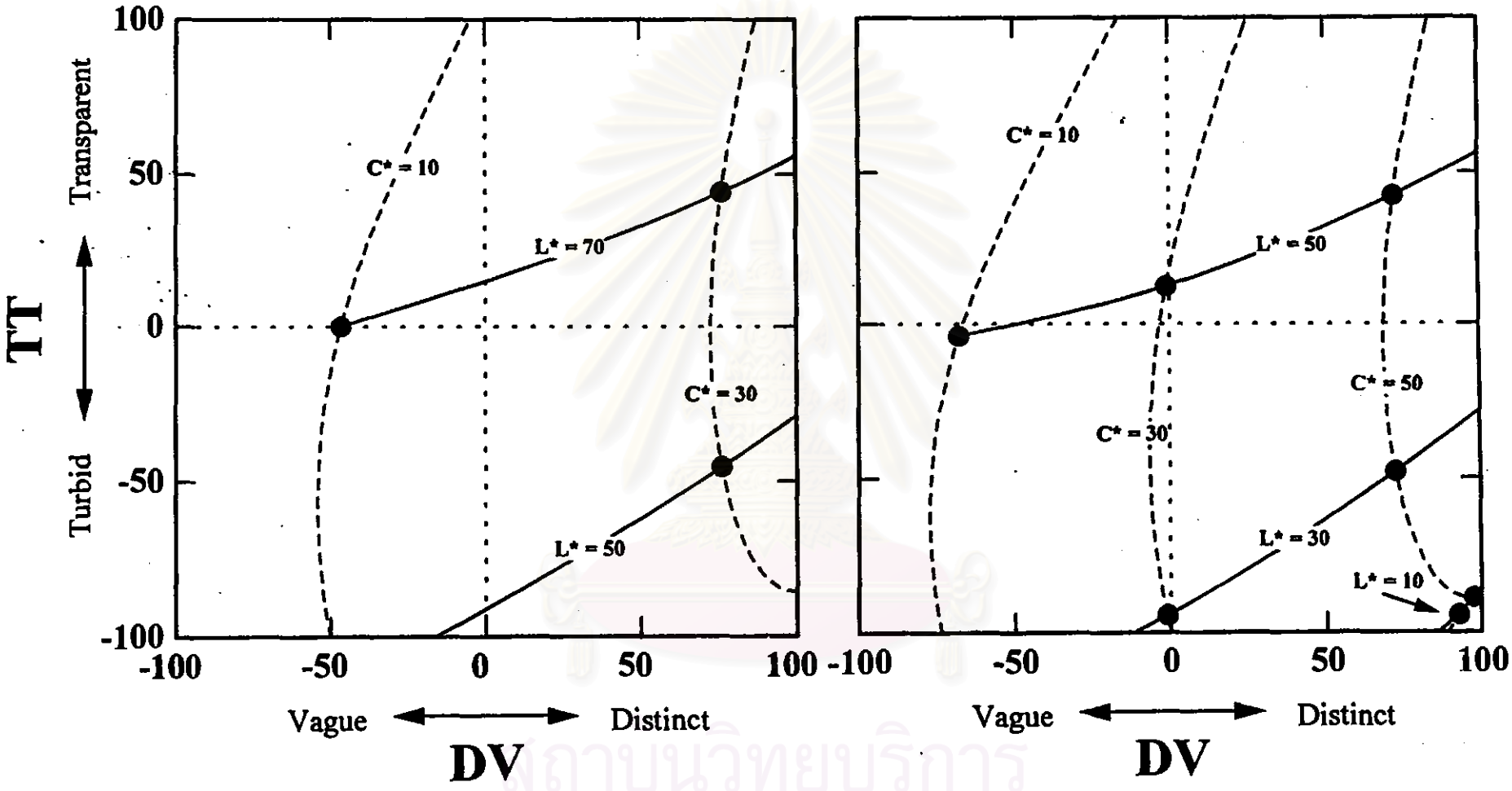


Figure 4-99 The projection of CIELAB color system on DV-TT color perception diagram: (a) h=270, (b) h=90

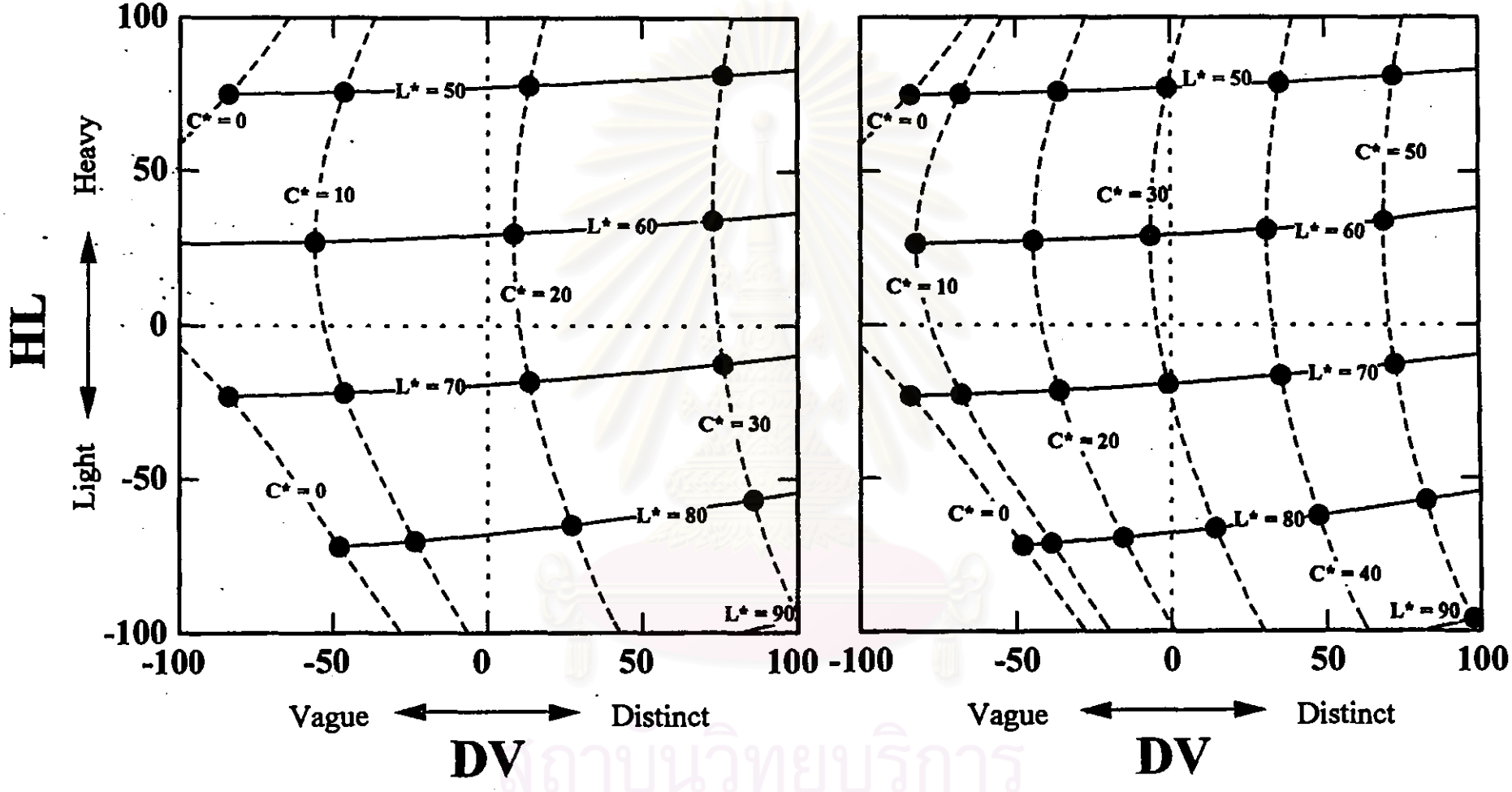


Figure 4-100 The projection of CIELAB color system on DV-HL color perception diagram: (a) h=270, (b) h=90

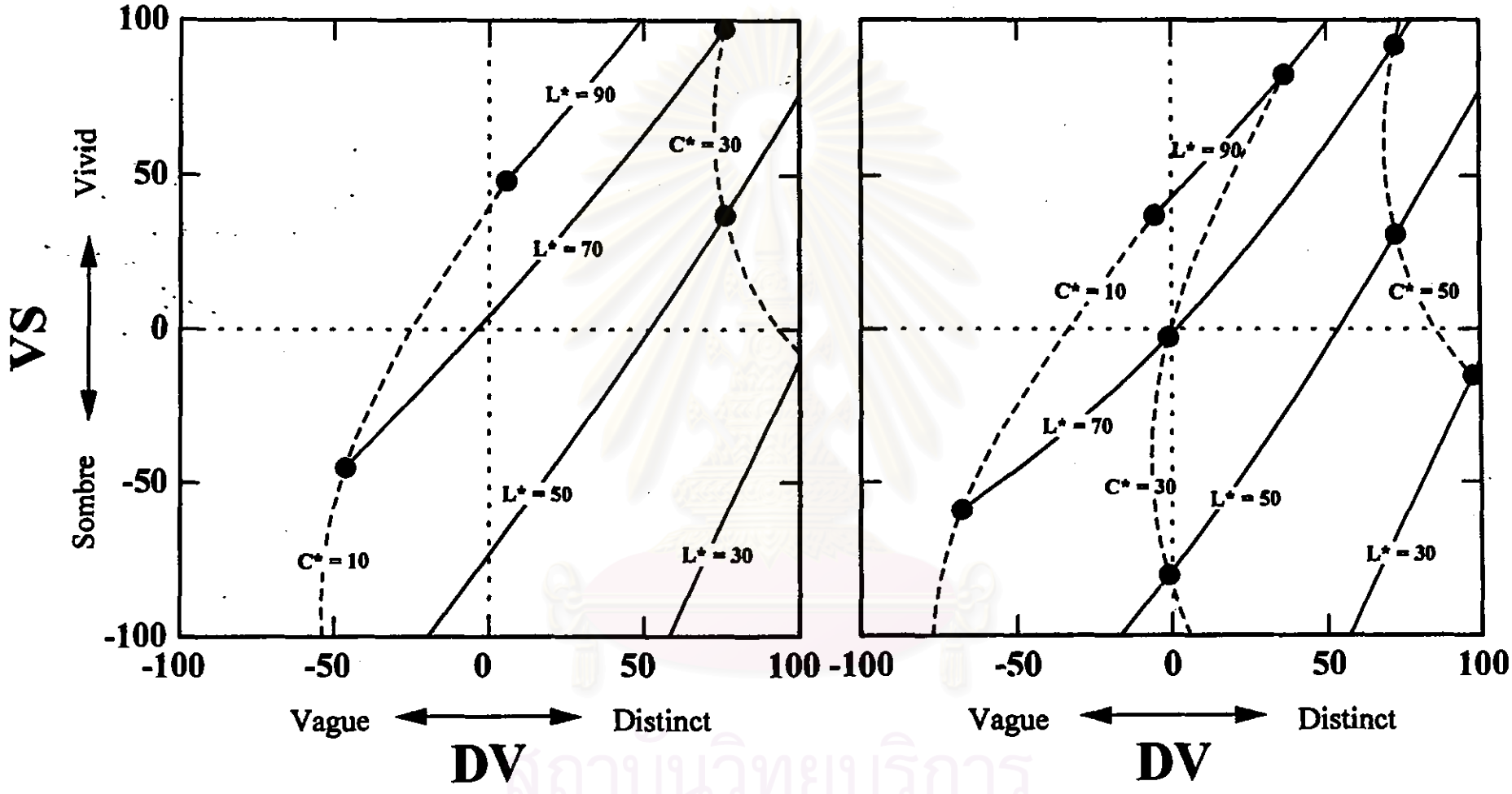


Figure 4-101 The projection of CIELAB color system on DV-VS color perception diagram: (a) h=270, (b) h=90

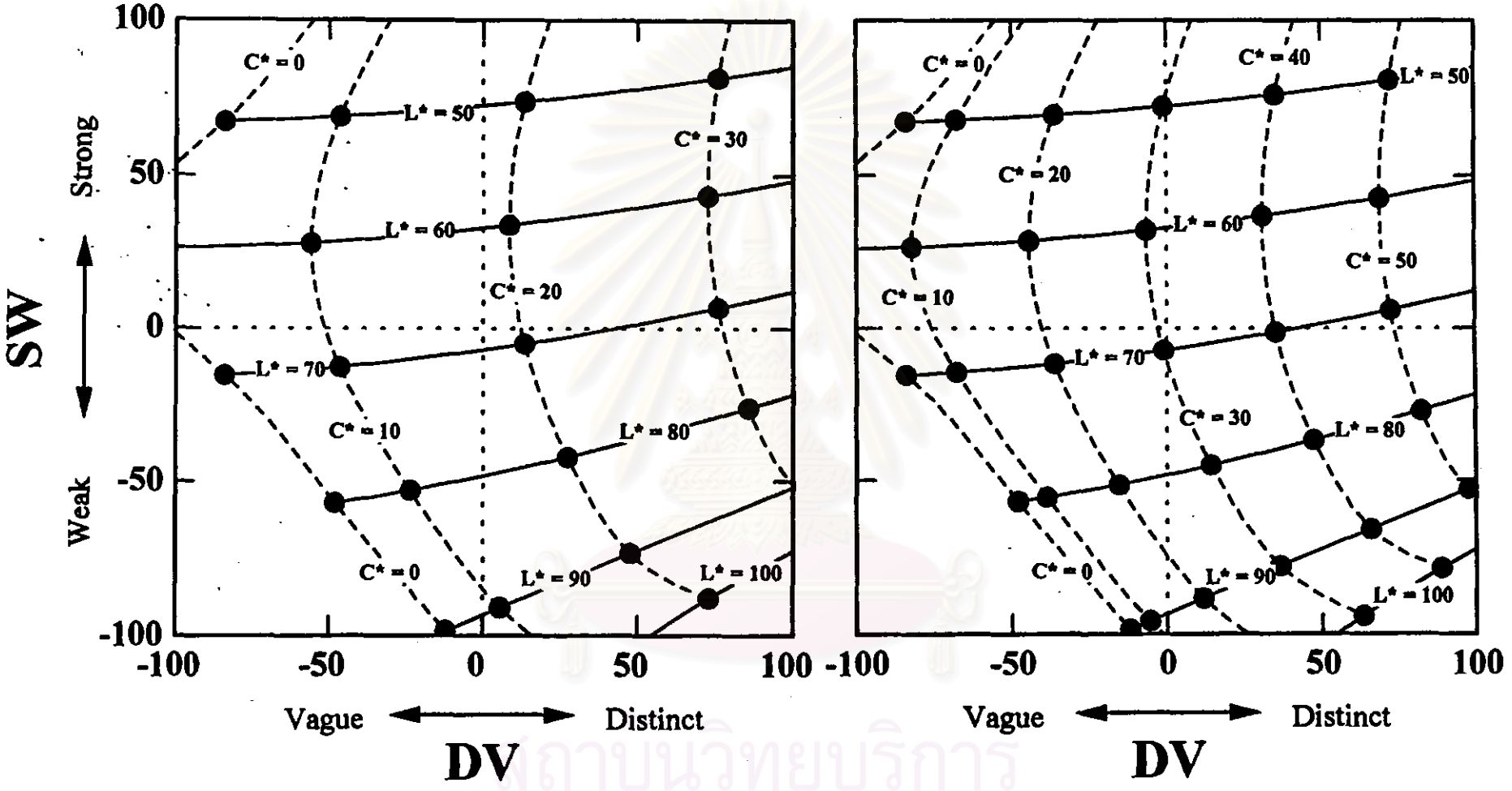


Figure 4-102 The projection of CIELAB color system on DV-SW color perception diagram: (a) h=270, (b) h=90

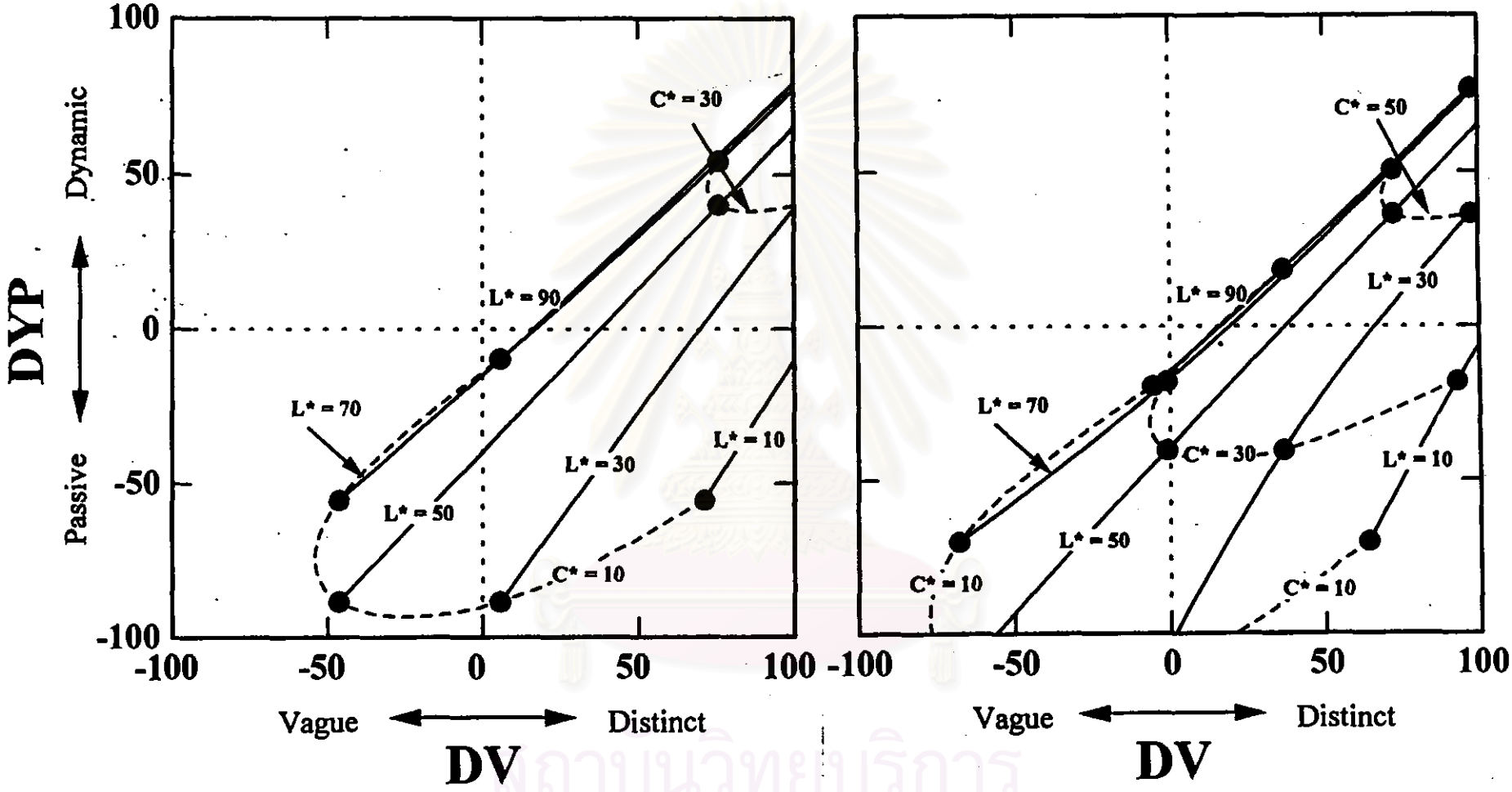
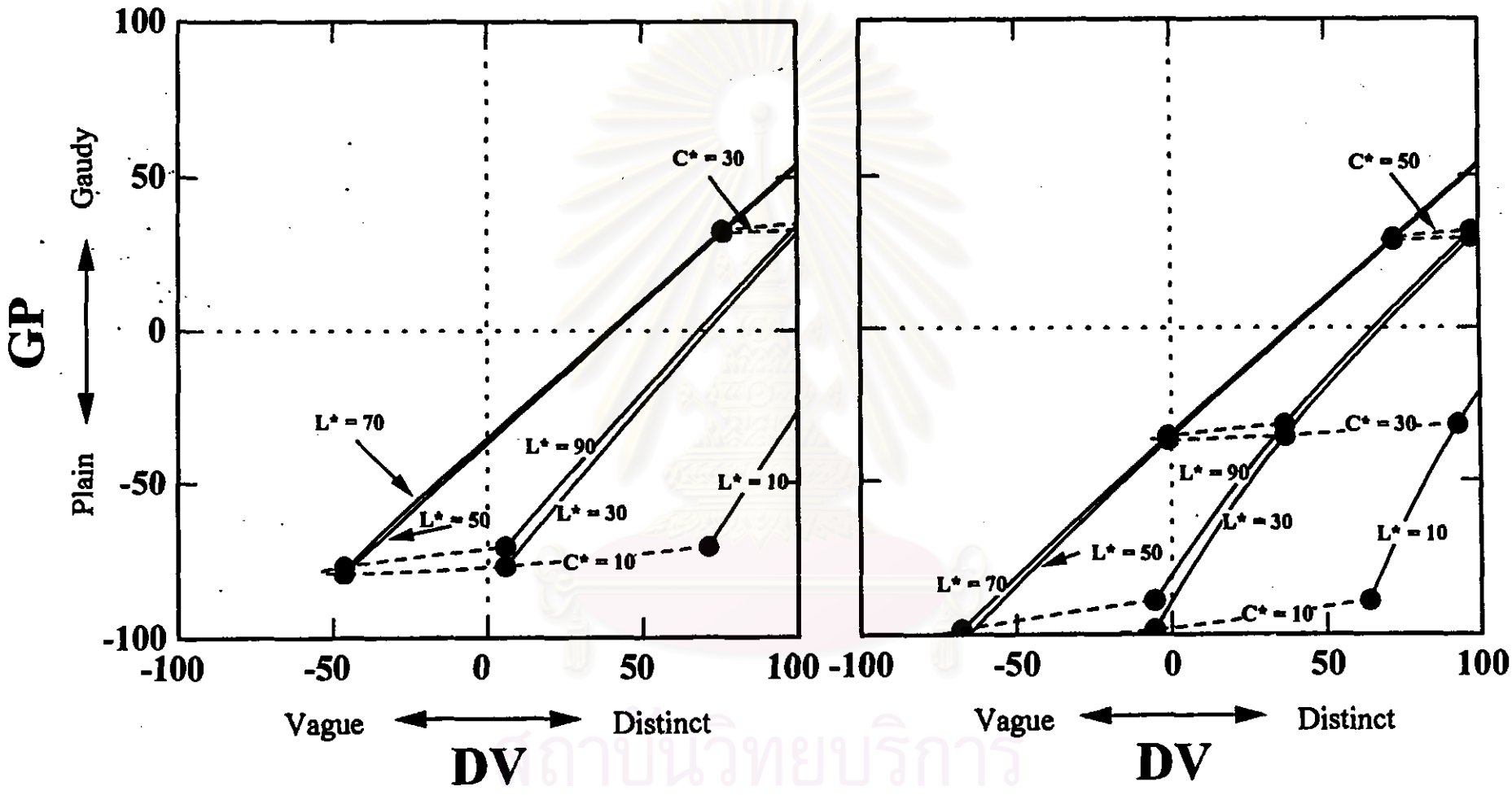


Figure 4-103 The projection of CIELAB color system on DV-DYP color perception diagram: (a) h=270, (b) h=90



(a) h=270 (b) h=90

Figure 4-104 The projection of CIELAB color system on DV-GP color perception diagram: (a) h=270, (b) h=90

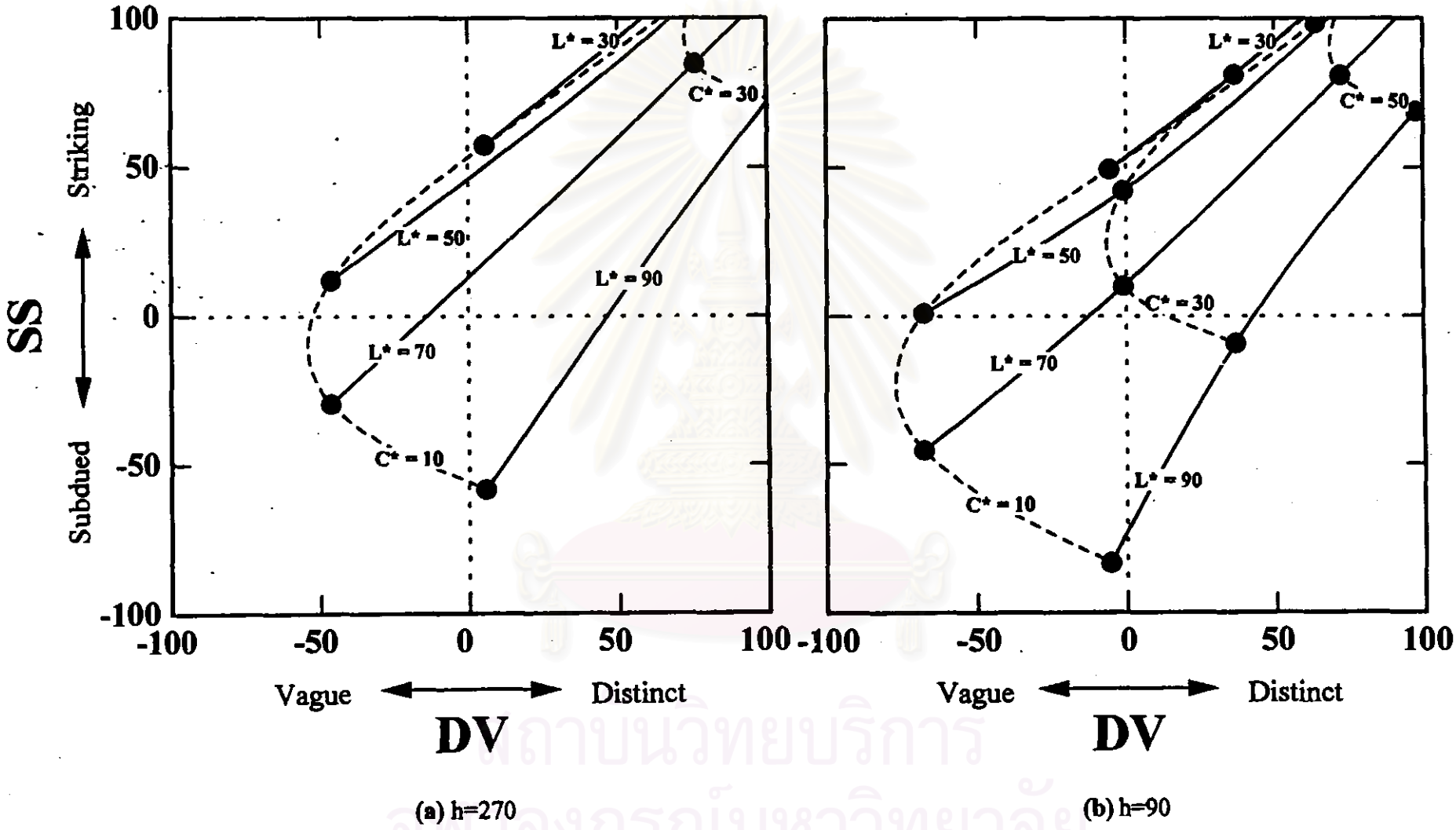


Figure 4-105 The projection of CIELAB color system on DV-SS color perception diagram: (a) h=270, (b) h=90

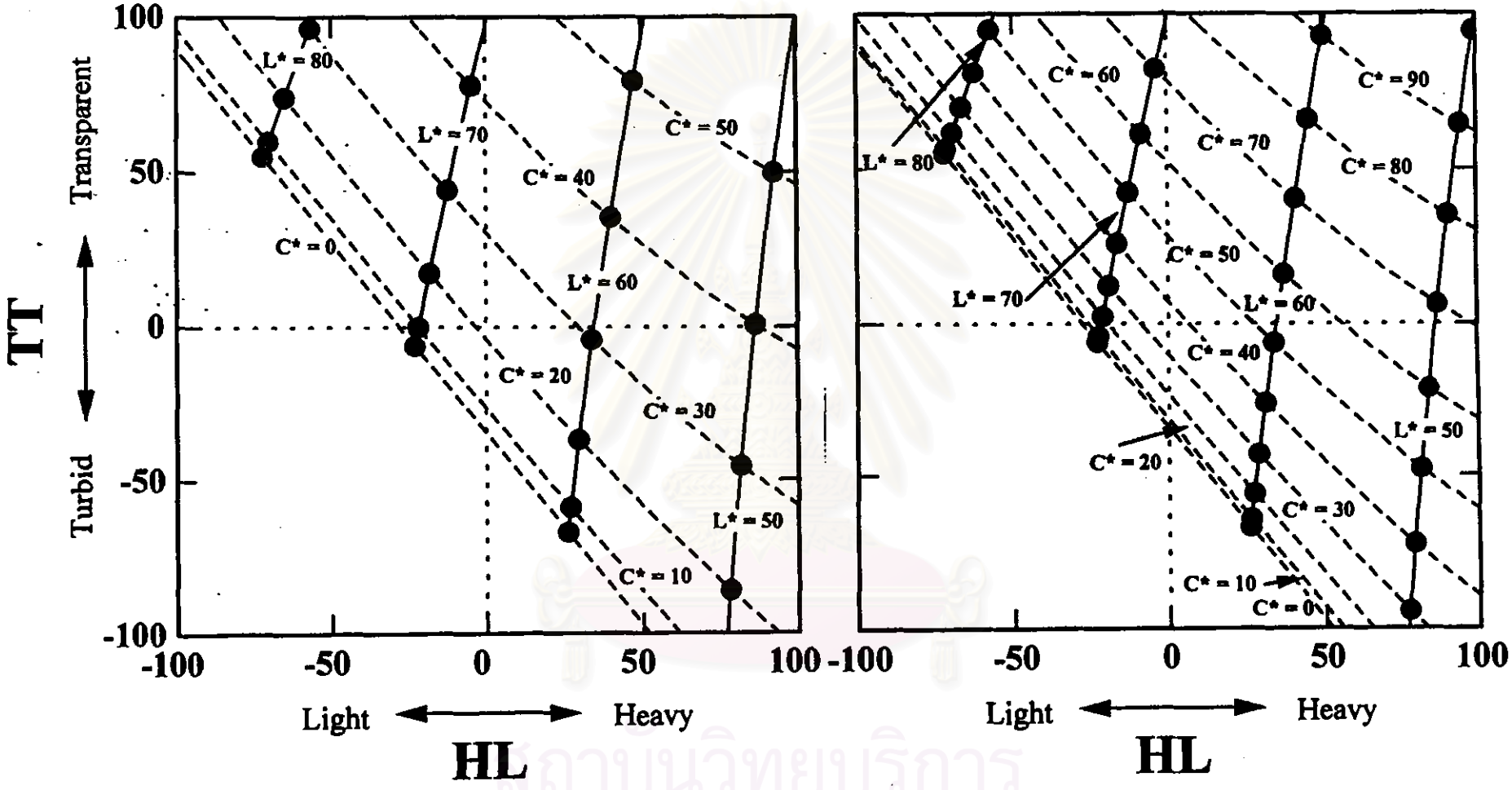


Figure 4-106 The projection of CIELAB color system on HL-TT color perception diagram: (a) h=270, (b) h=90

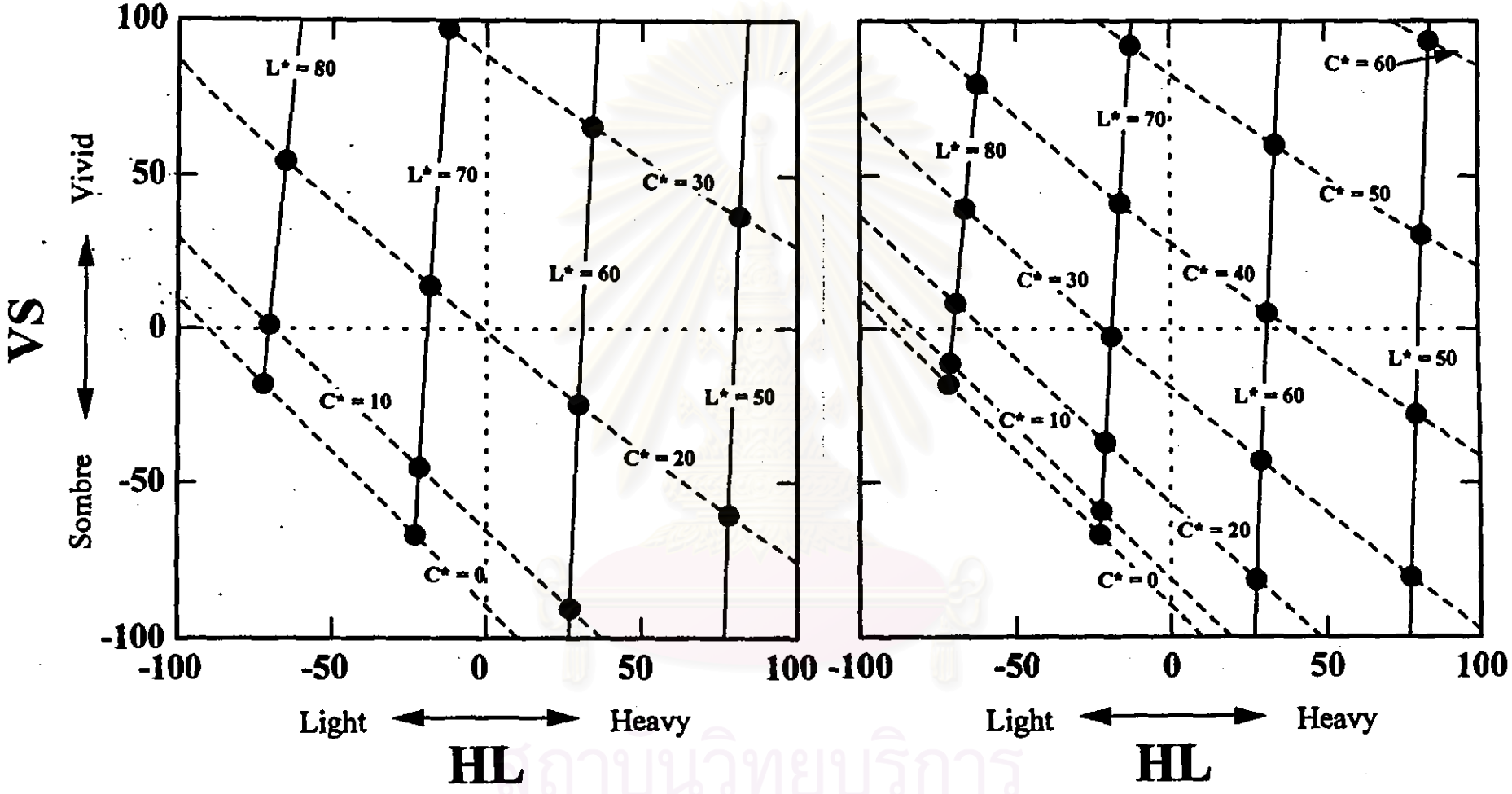


Figure 4-107 The projection of CIELAB color system on HL-VS color perception diagram: (a) h=270, (b) h=90

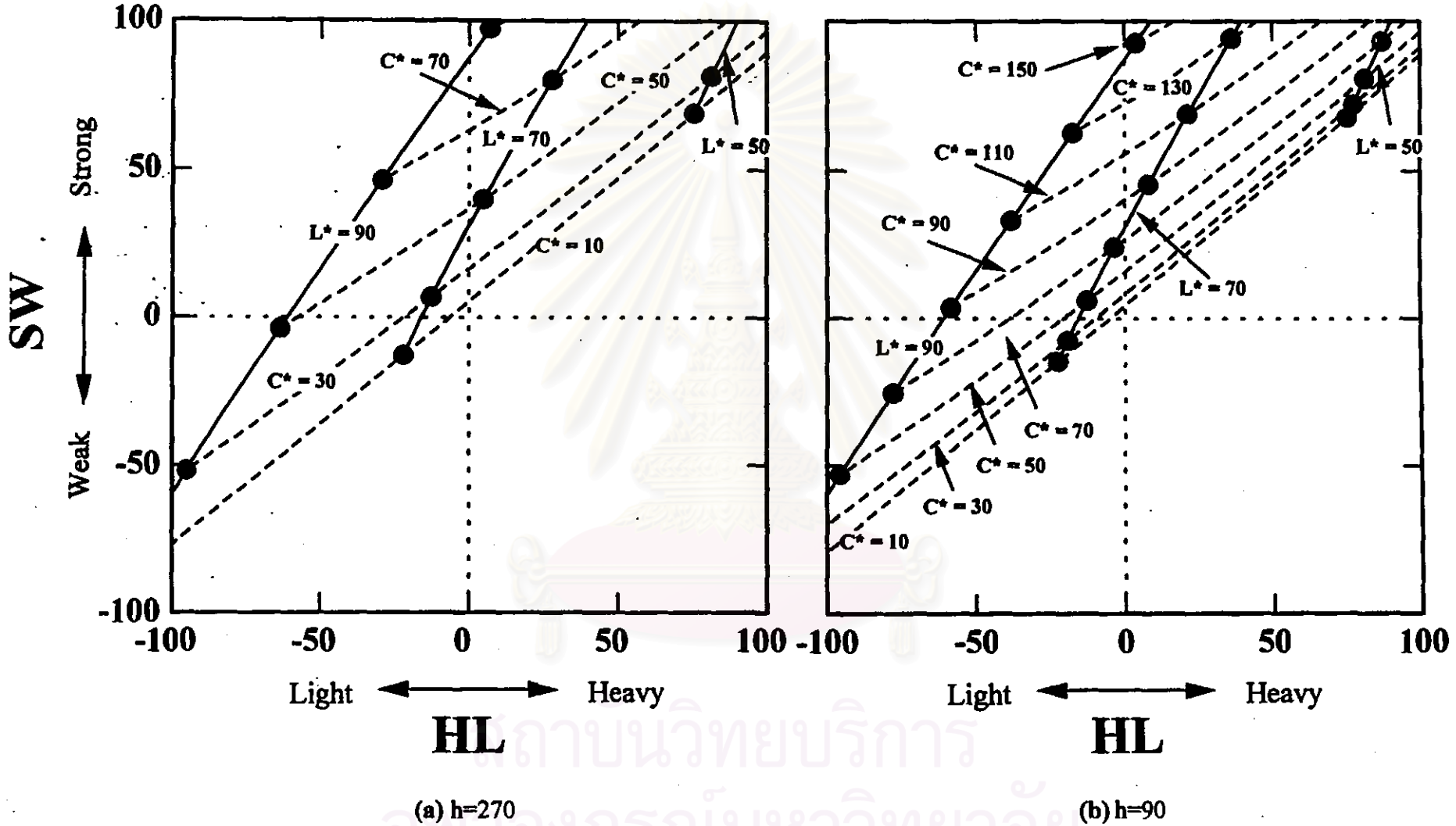


Figure 4-108 The projection of CIELAB color system on HL-SW color perception diagram: (a) h=270, (b) h=90

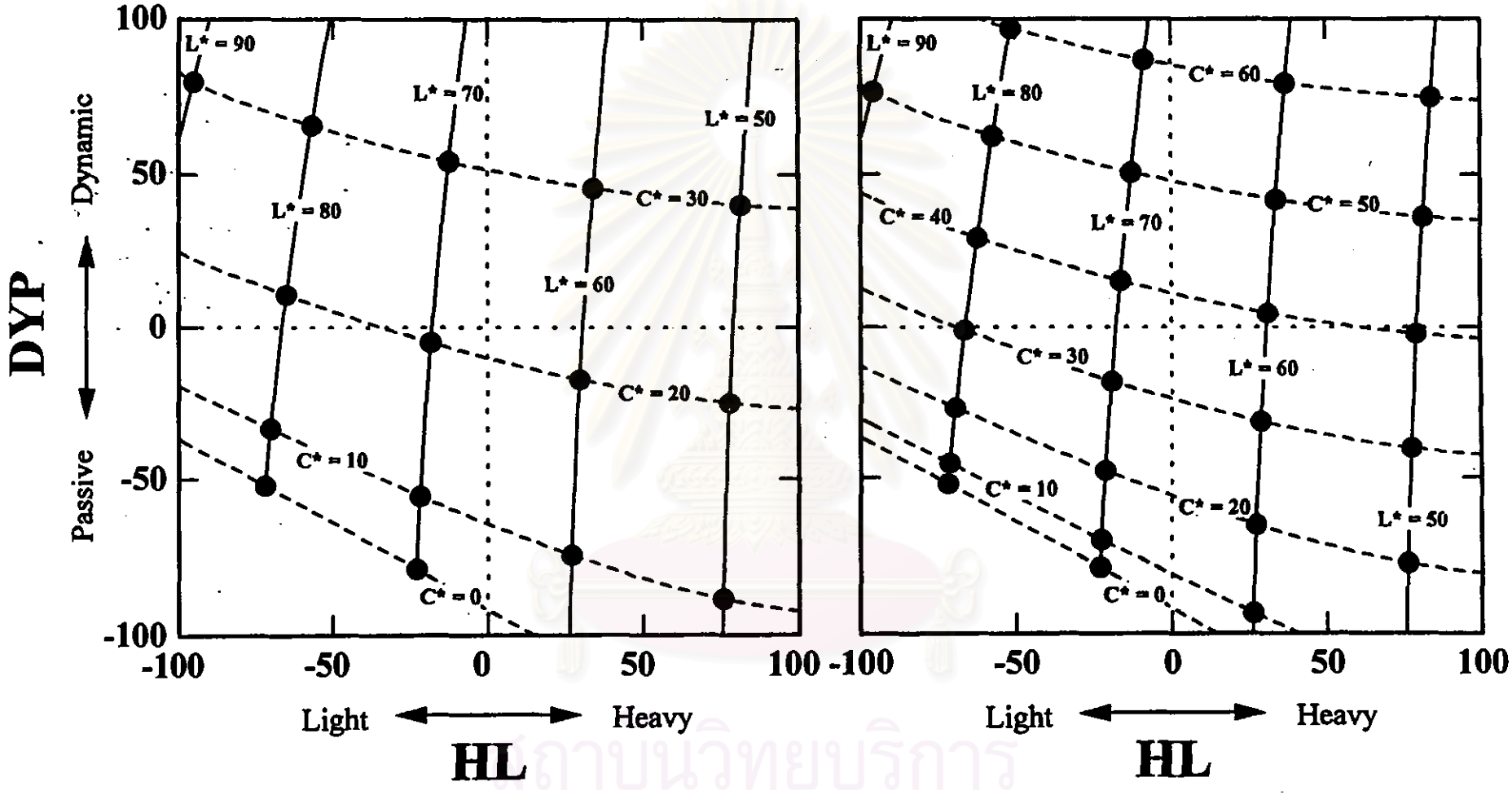


Figure 4-109 The projection of CIELAB color system on HL-DYP color perception diagram: (a) h=270, (b) h=90

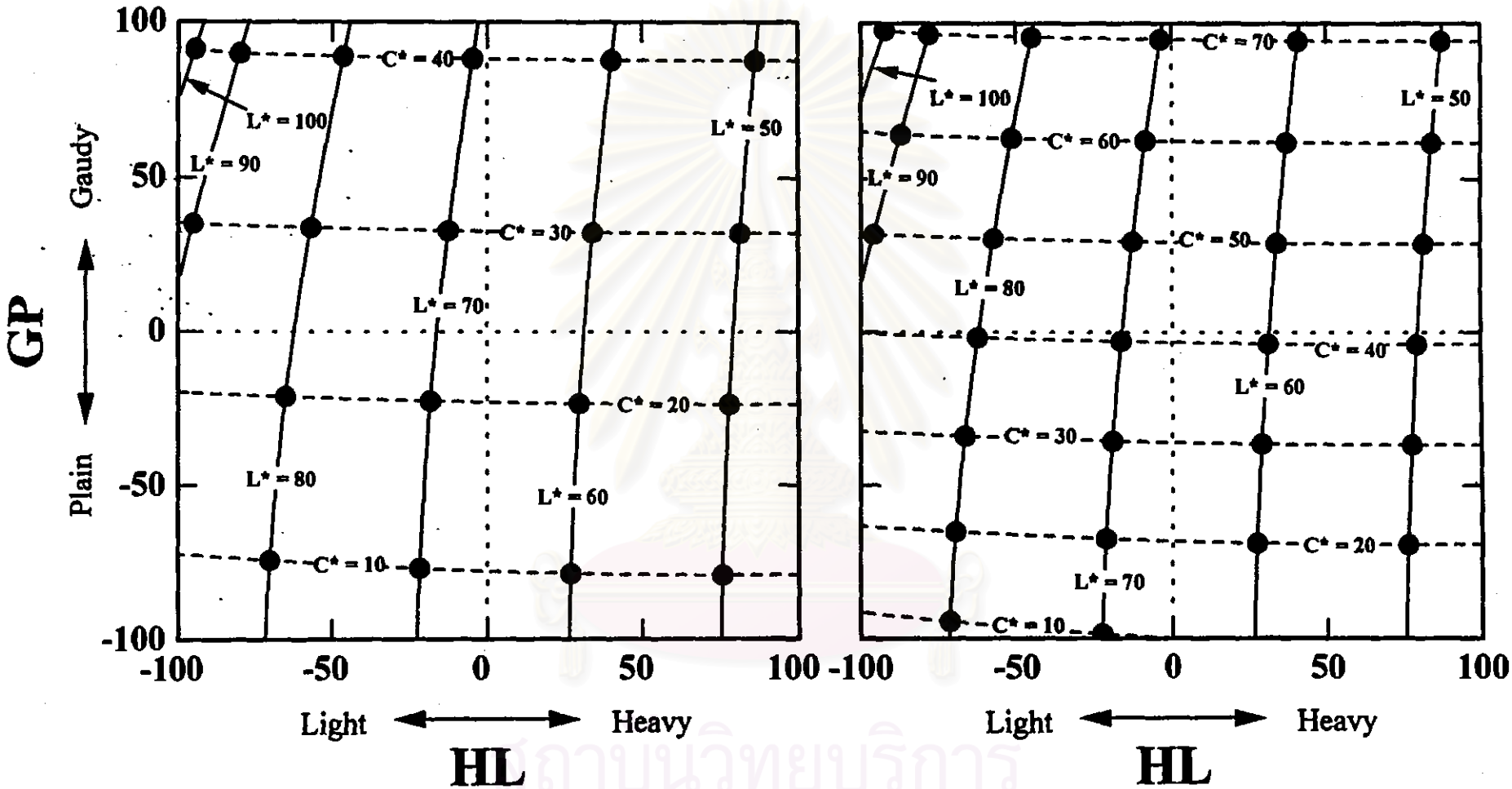


Figure 4-110 The projection of CIELAB color system on HL-GP color perception diagram: (a) h=270, (b) h=90

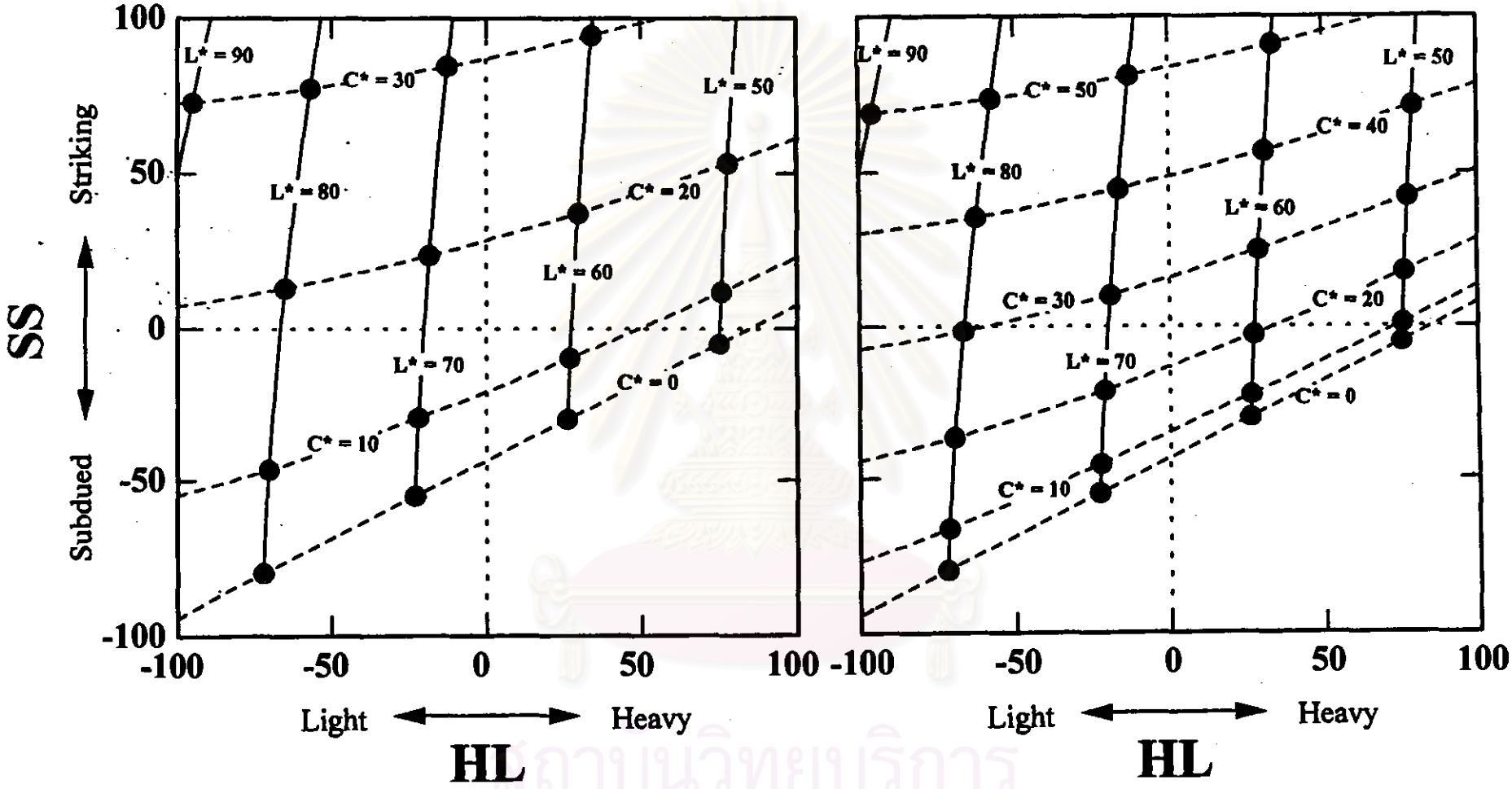


Figure 4-111 The projection of CIELAB color system on HL-SS color perception diagram: (a) h=270, (b) h=90

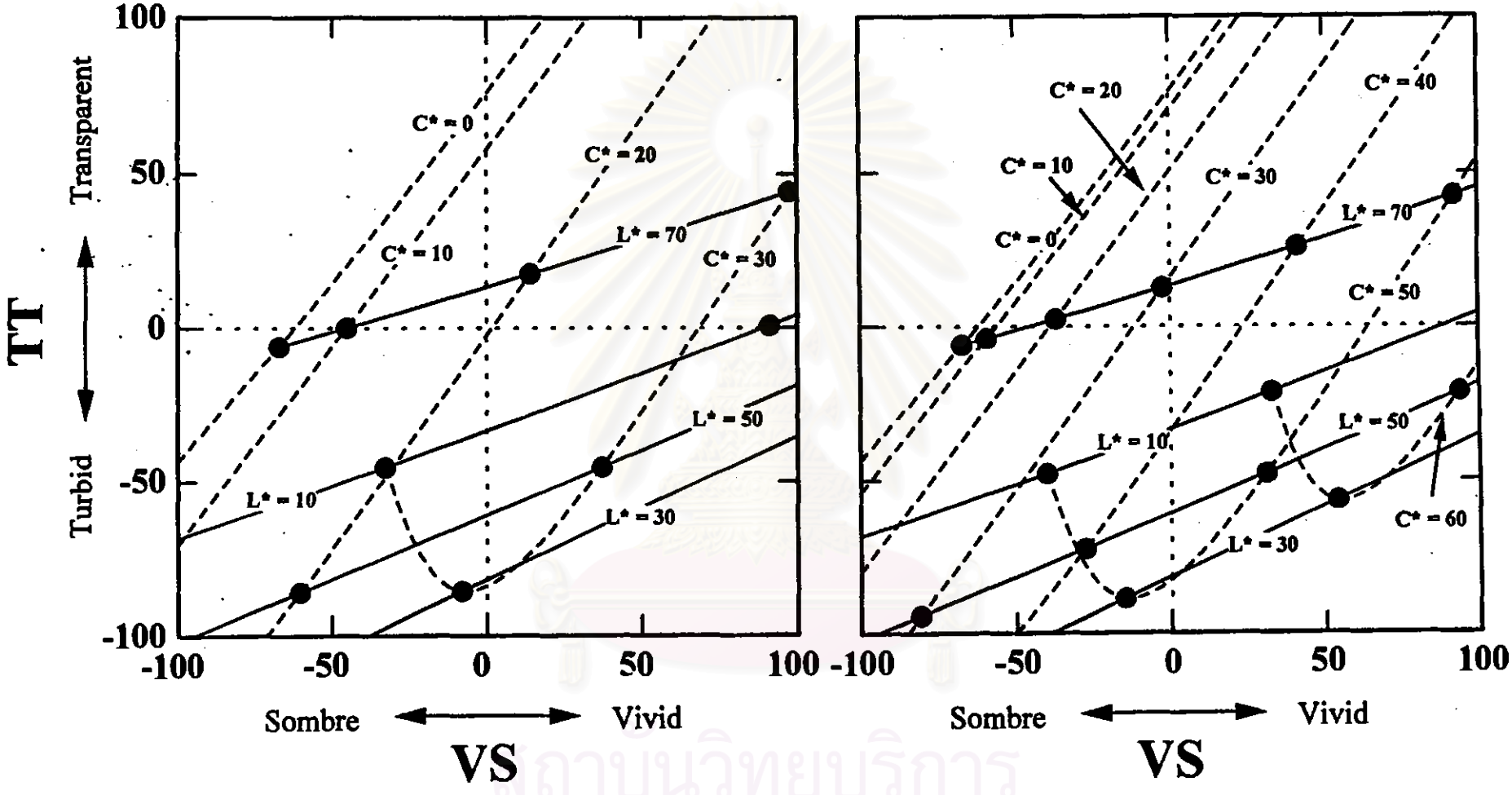


Figure 4-112 The projection of CIELAB color system on VS-TT color perception diagram: (a) h=270, (b) h=90

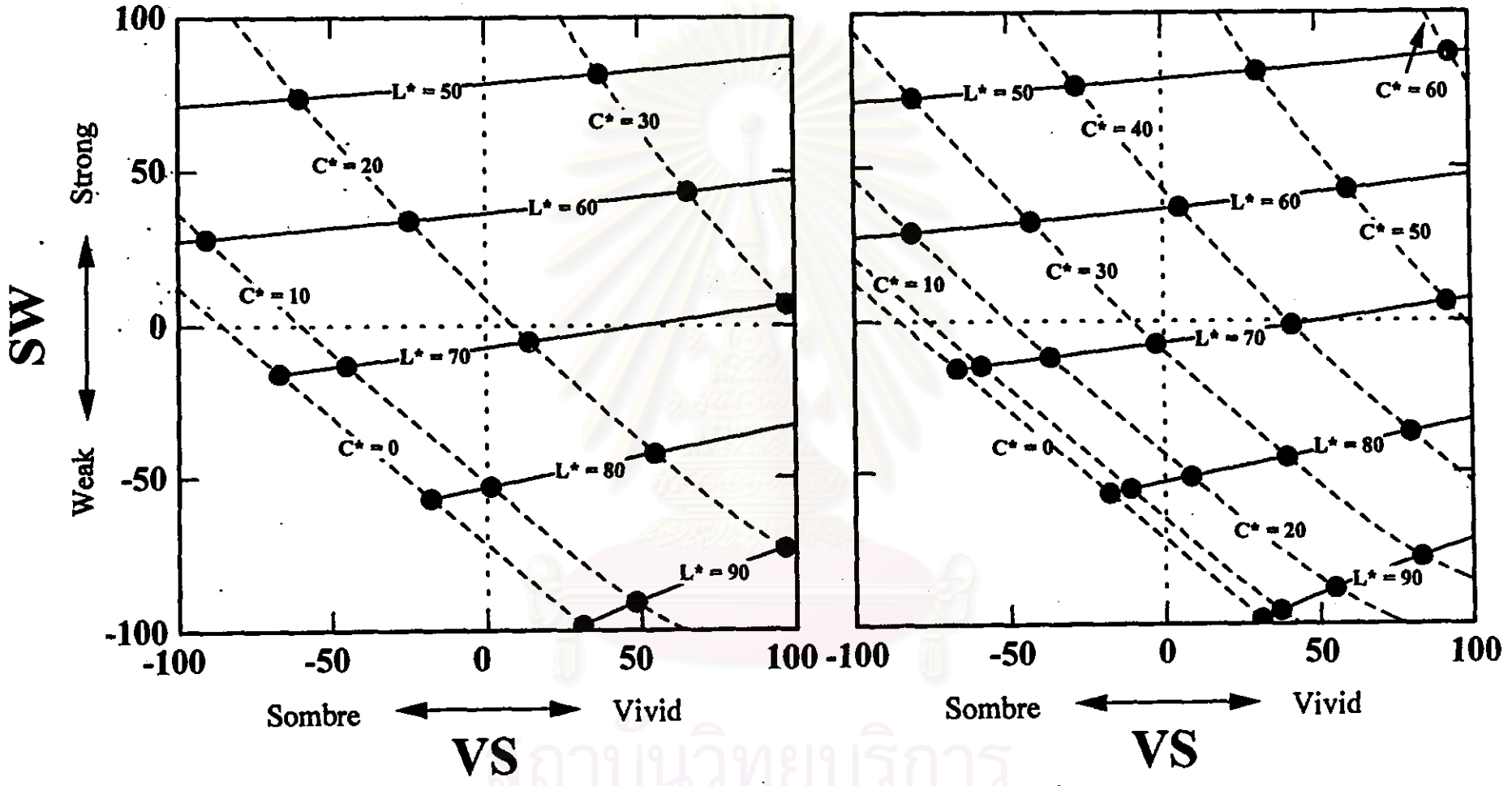


Figure 4-113 The projection of CIELAB color system on VS-SW color perception diagram: (a) h=270, (b) h=90

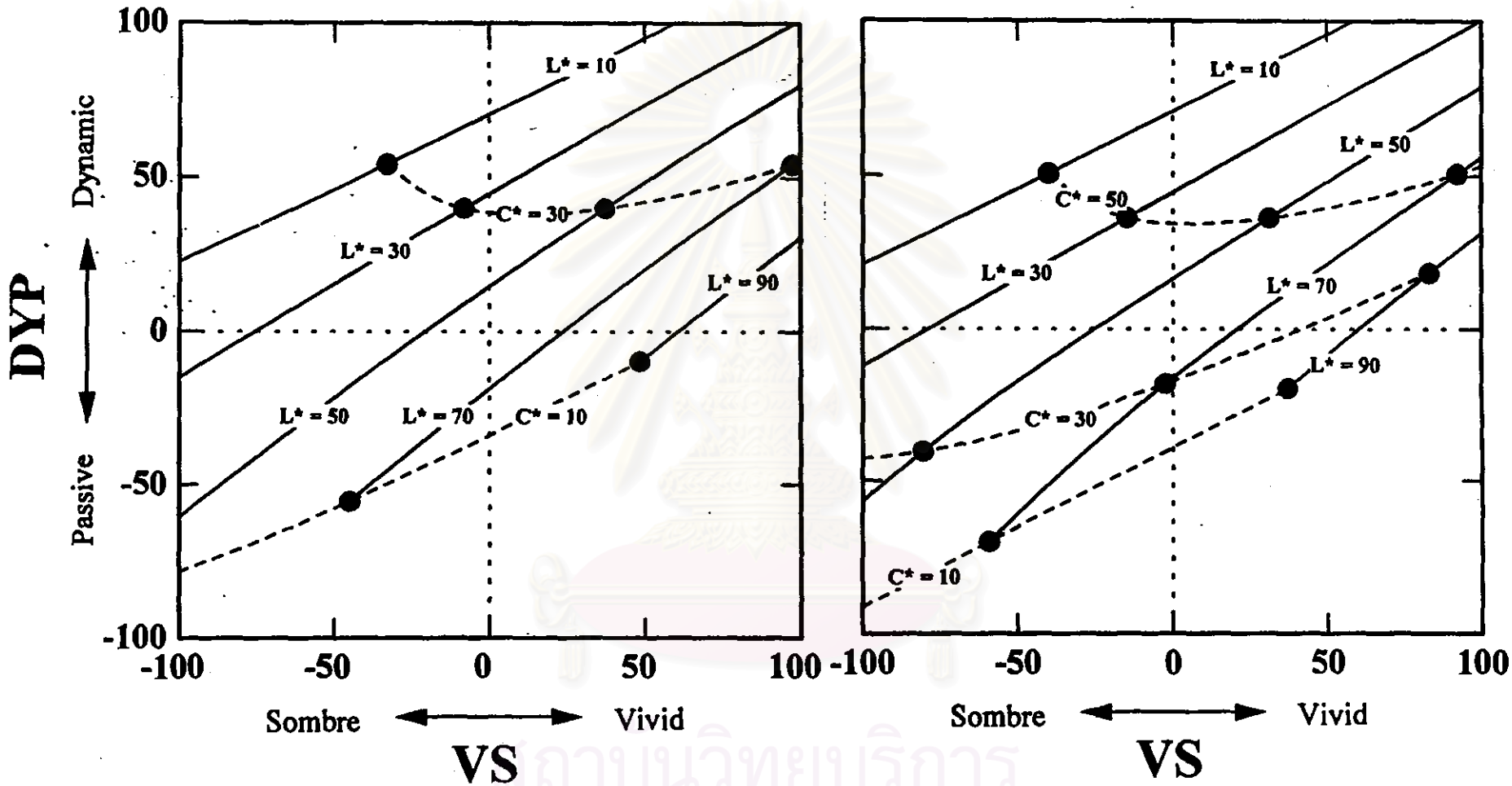


Figure 4-114 The projection of CIELAB color system on VS-DYP color perception diagram: (a) h=270, (b) h=90

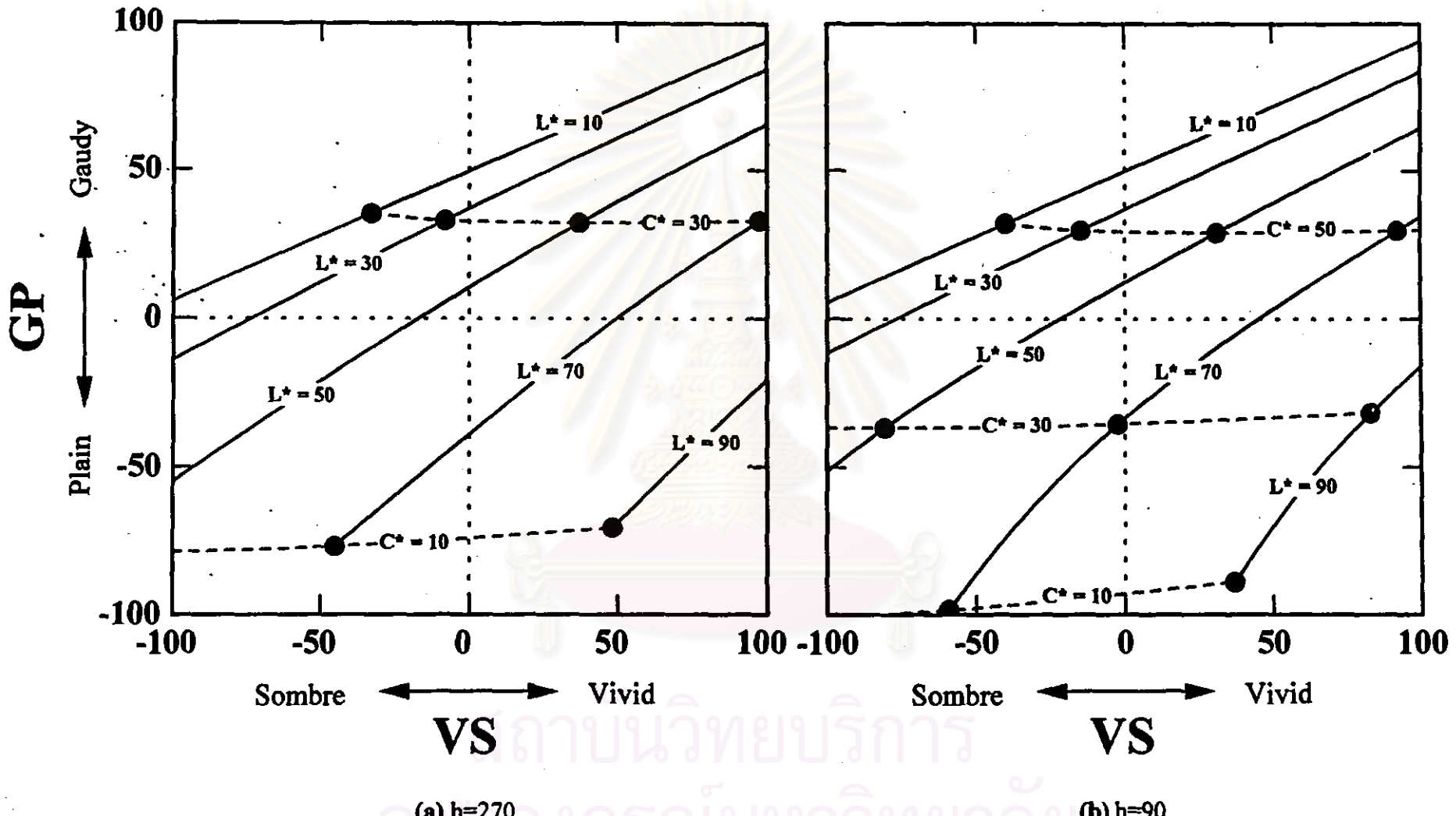
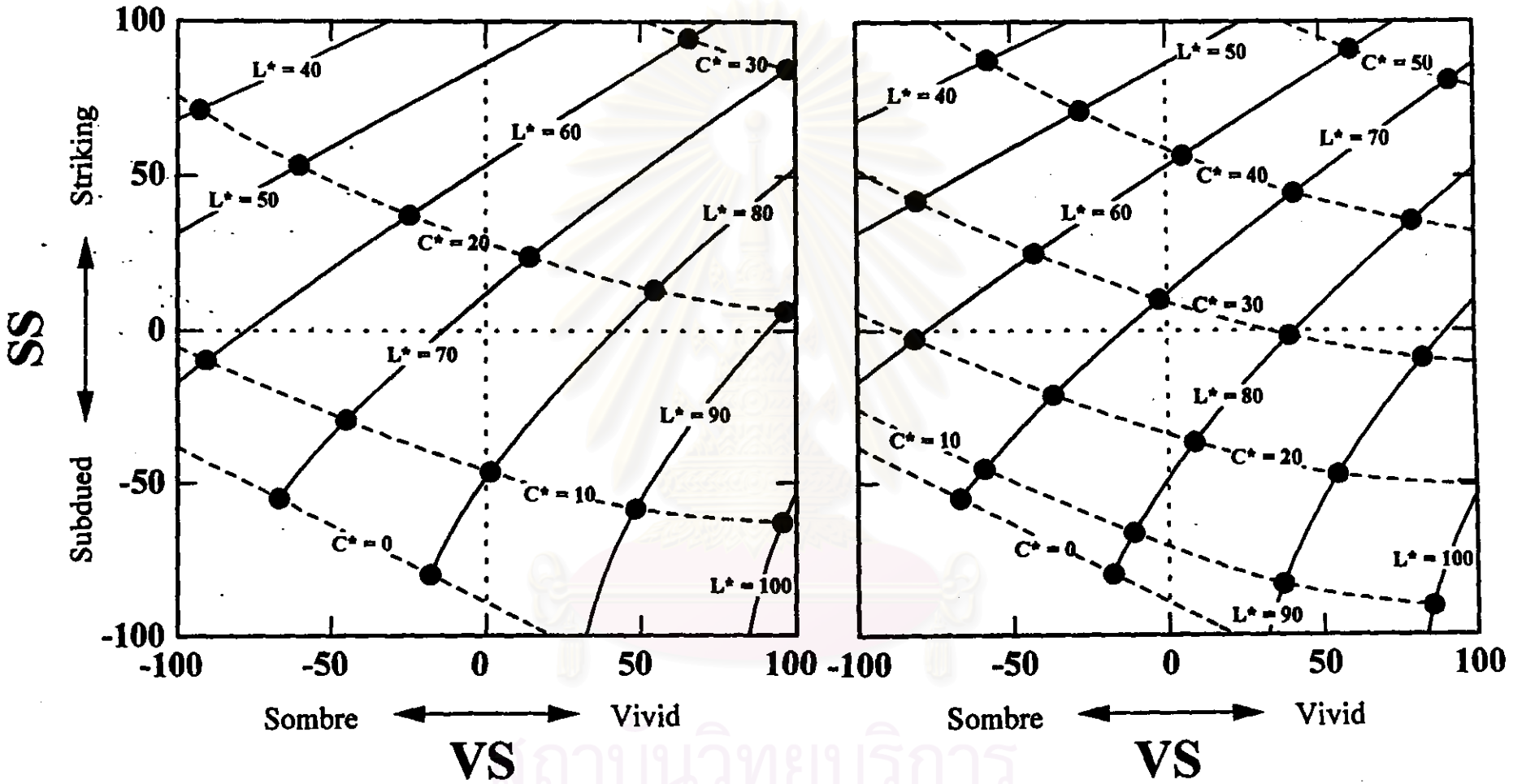


Figure 4-115 The projection of CIELAB color system on VS-GP color perception diagram: (a) h=270, (b) h=90



(a) h=270 (b) h=90

Figure 4-116 The projection of CIELAB color system on VS-SS color perception diagram: (a) h=270, (b) h=90

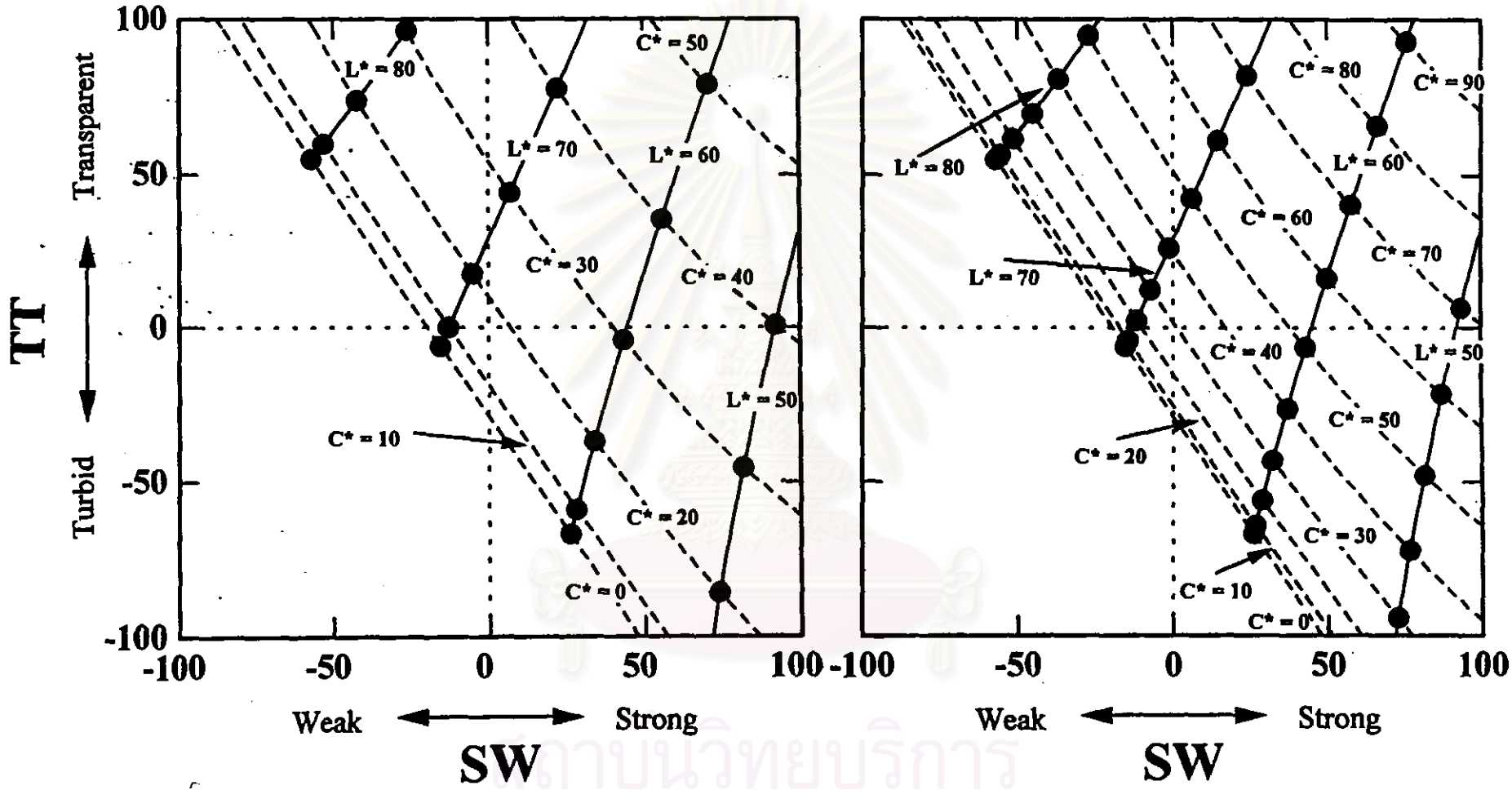


Figure 4-117 The projection of CIELAB color system on SW-TT color perception diagram: (a) h=270, (b) h=90

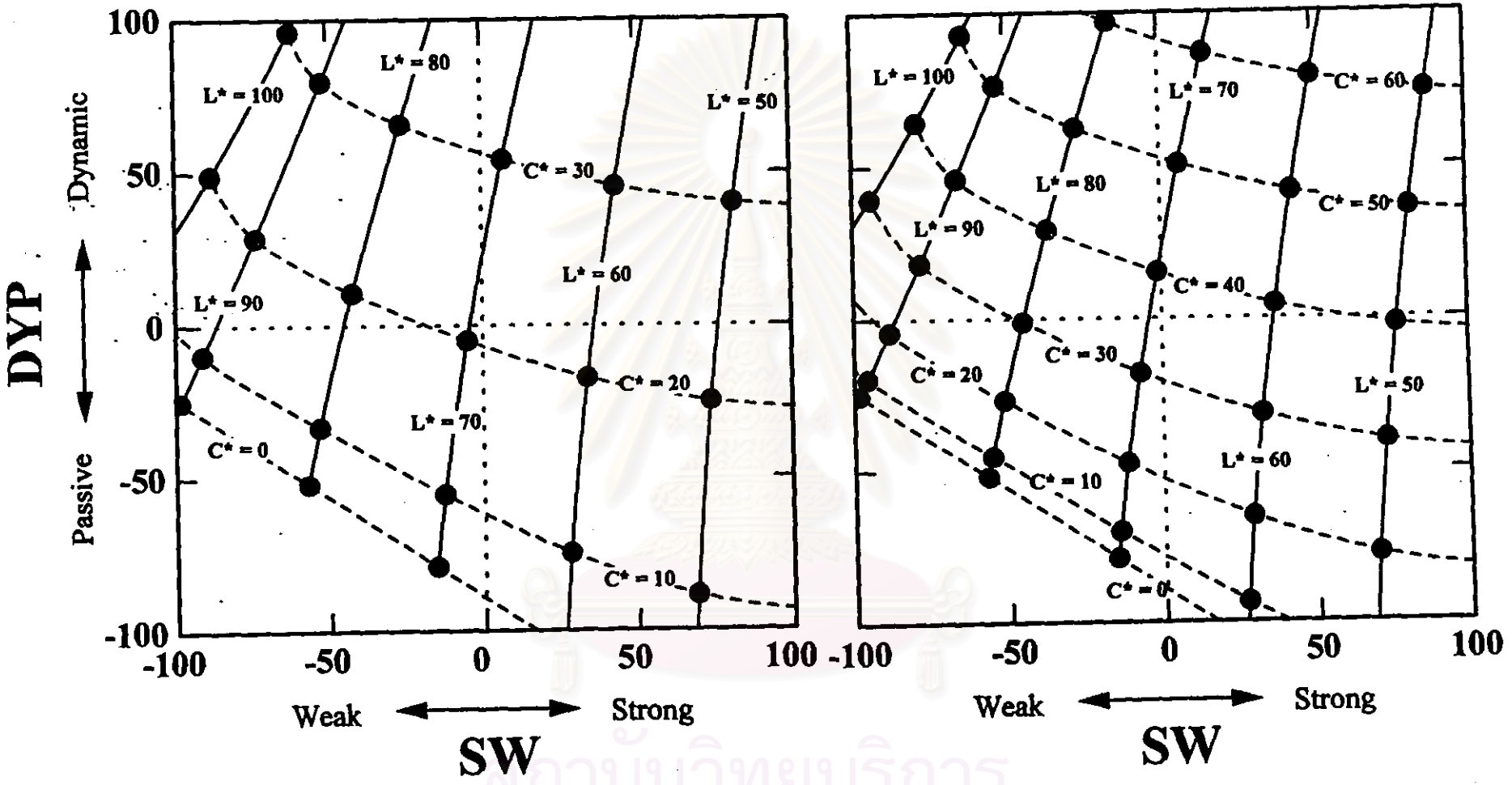


Figure 4-118 The projection of CIELAB color system on SW-DYP color perception diagram: (a) h=270, (b) h=90

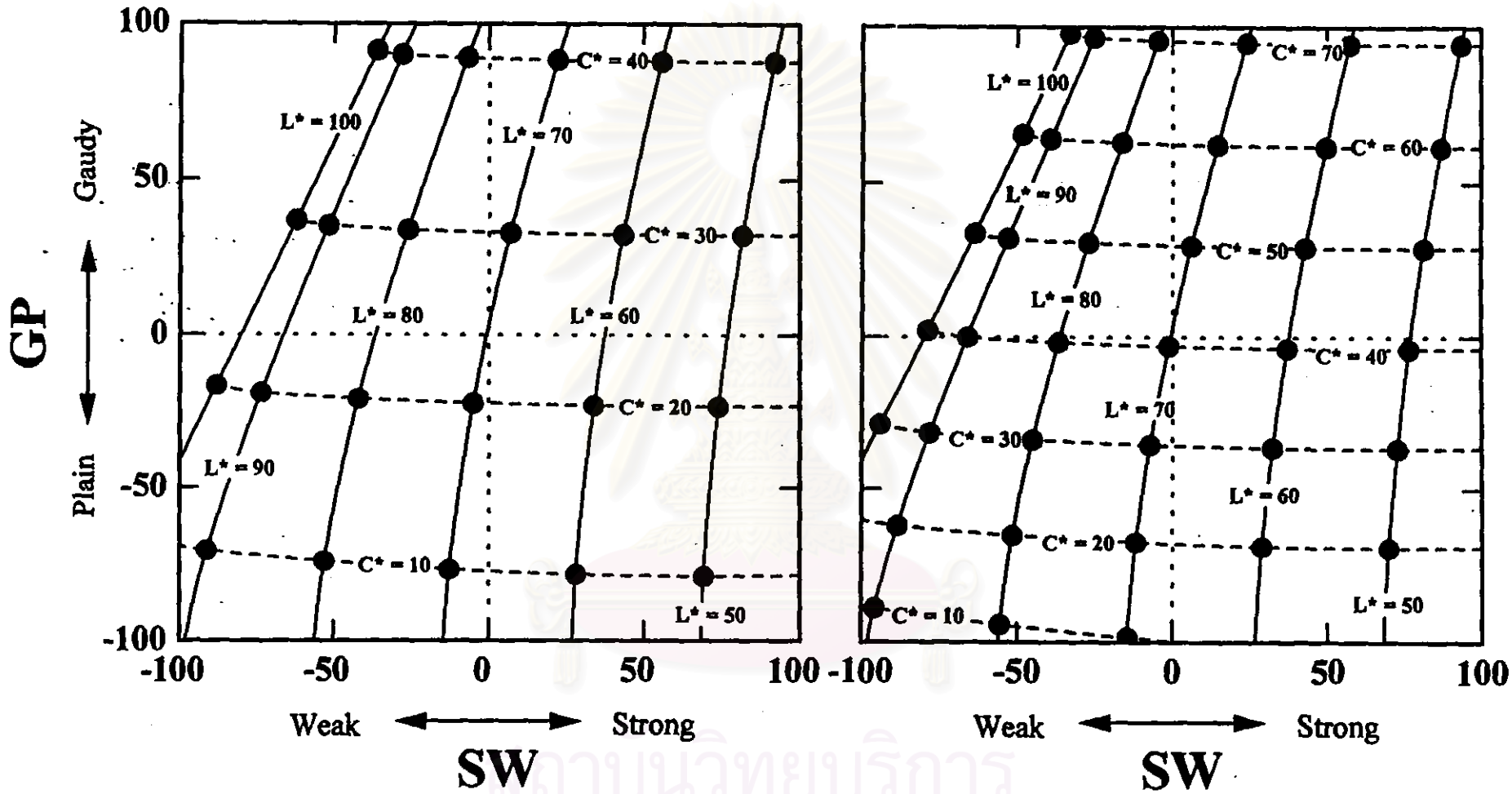


Figure 4-119 The projection of CIELAB color system on SW-GP color perception diagram: (a) h=270, (b) h=90

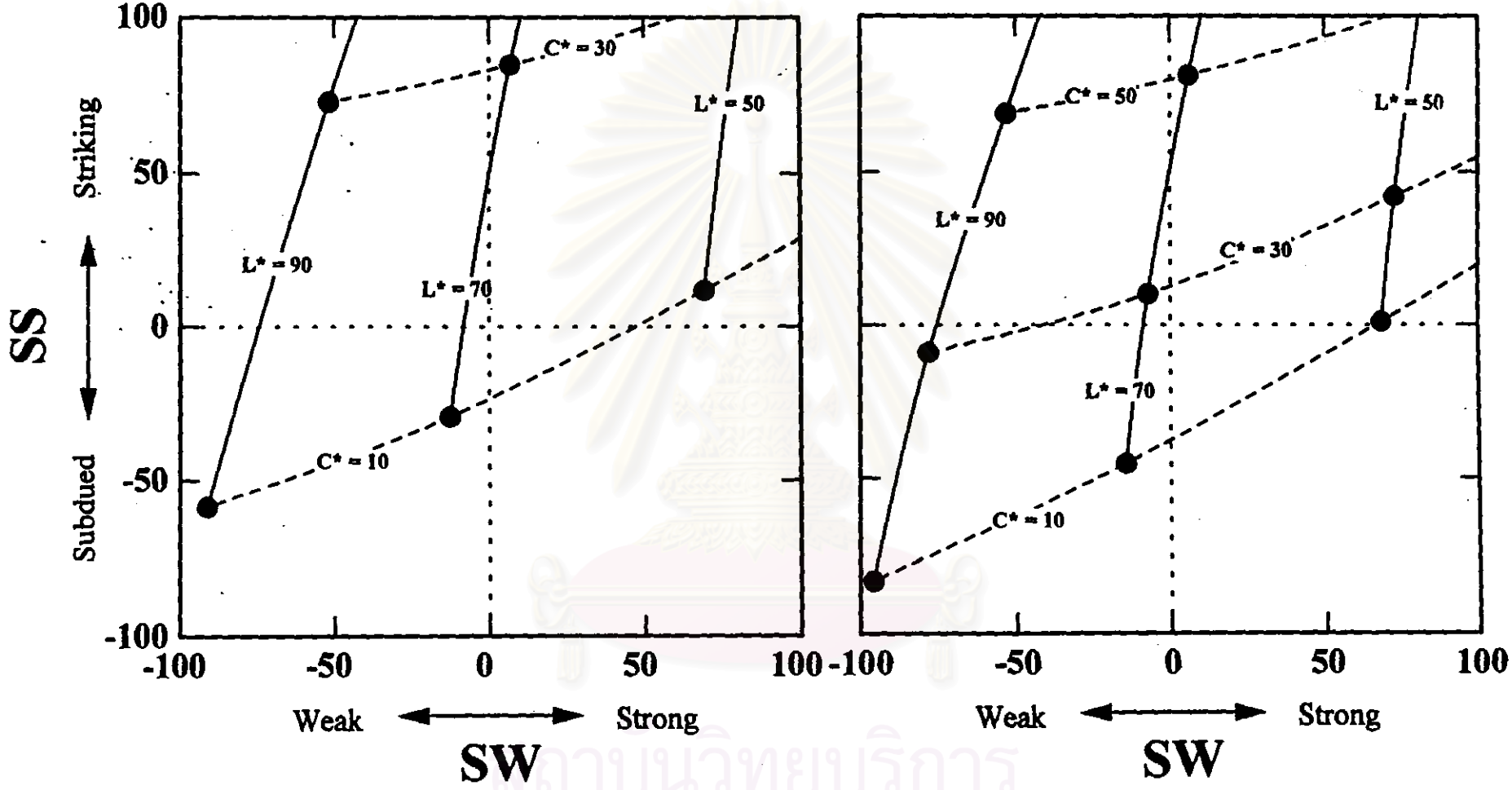
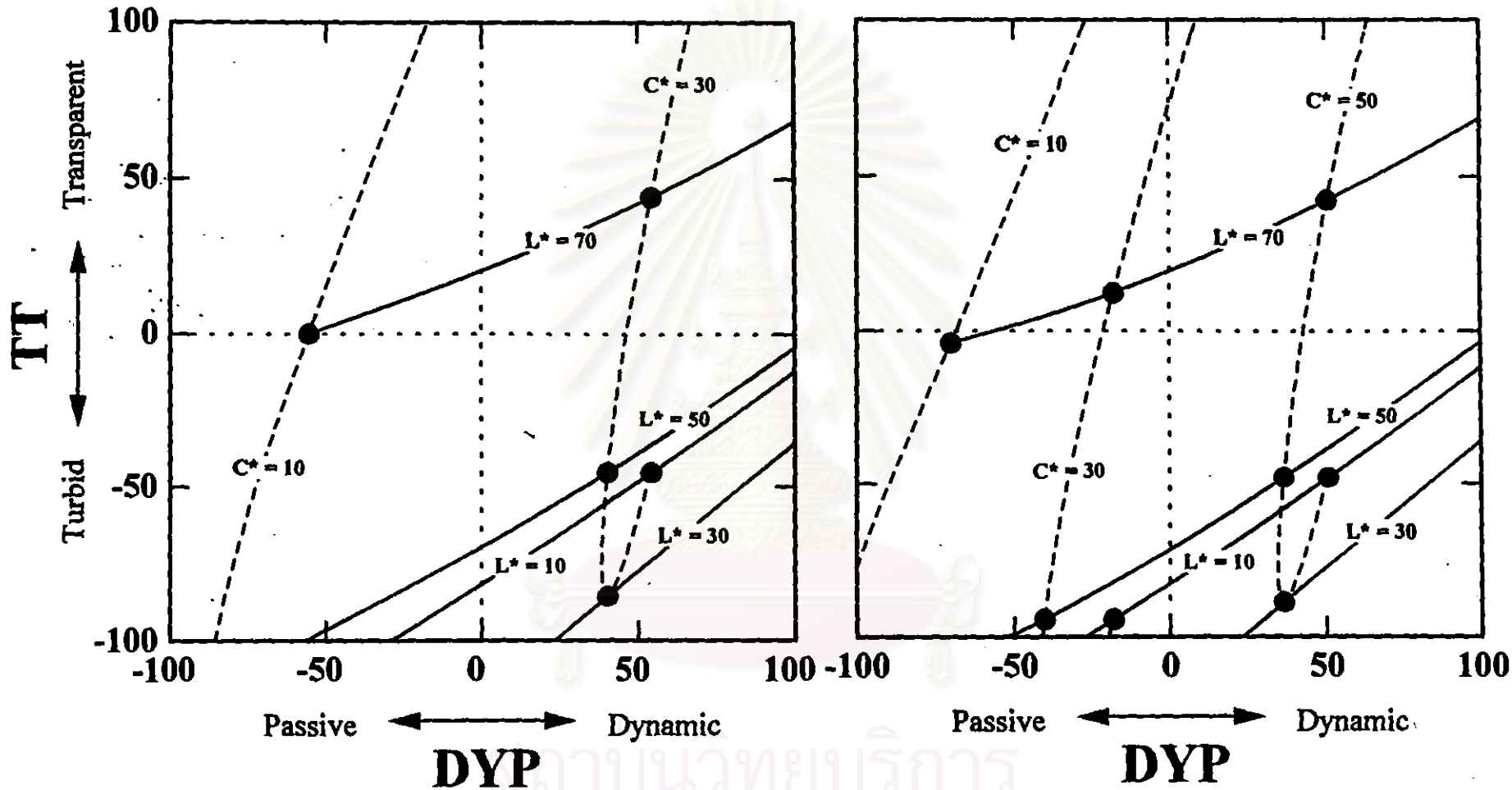


Figure 4-120 The projection of CIELAB color system on SW-SS color perception diagram: (a) h=270, (b) h=90



(a) h=270 (b) h=90

Figure 4-121 The projection of CIELAB color system on DYP-TT color perception diagram: (a) h=270, (b) h=90

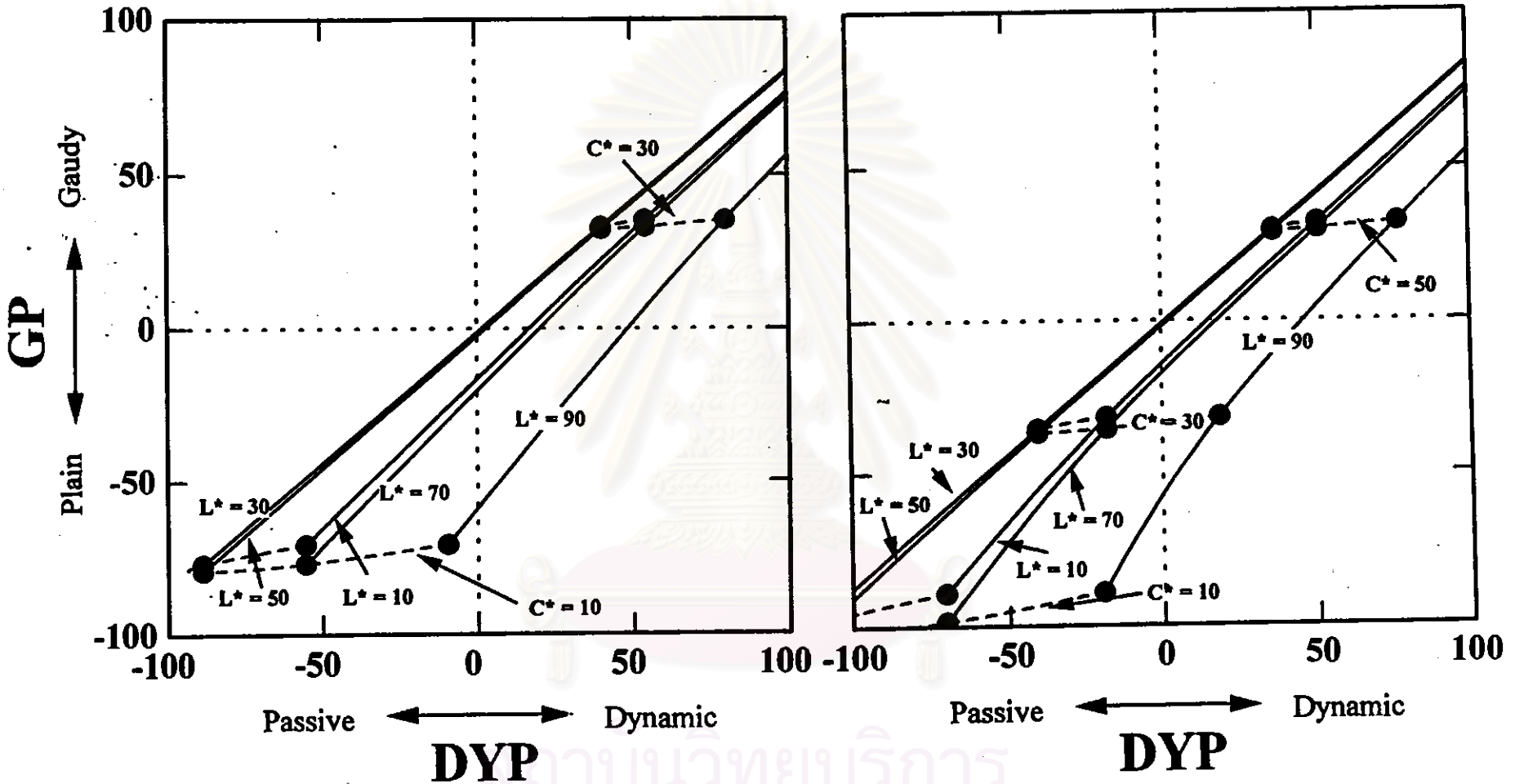


Figure 4-122 The projection of CIELAB color system on DYP-GP color perception diagram: (a) h=270, (b) h=90

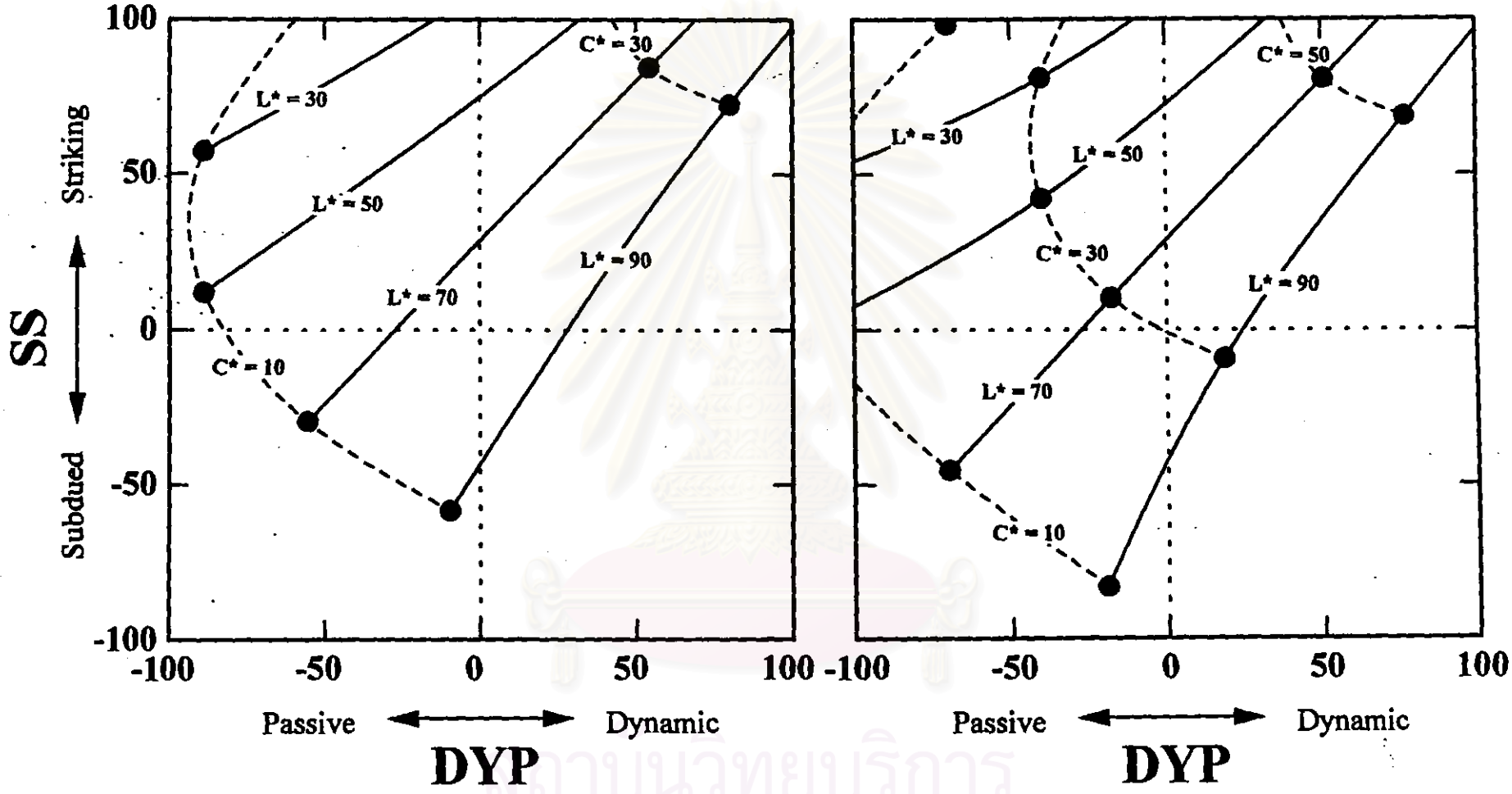


Figure 4-123 The projection of CIELAB color system on DYP-SS color perception diagram: (a) h=270, (b) h=90

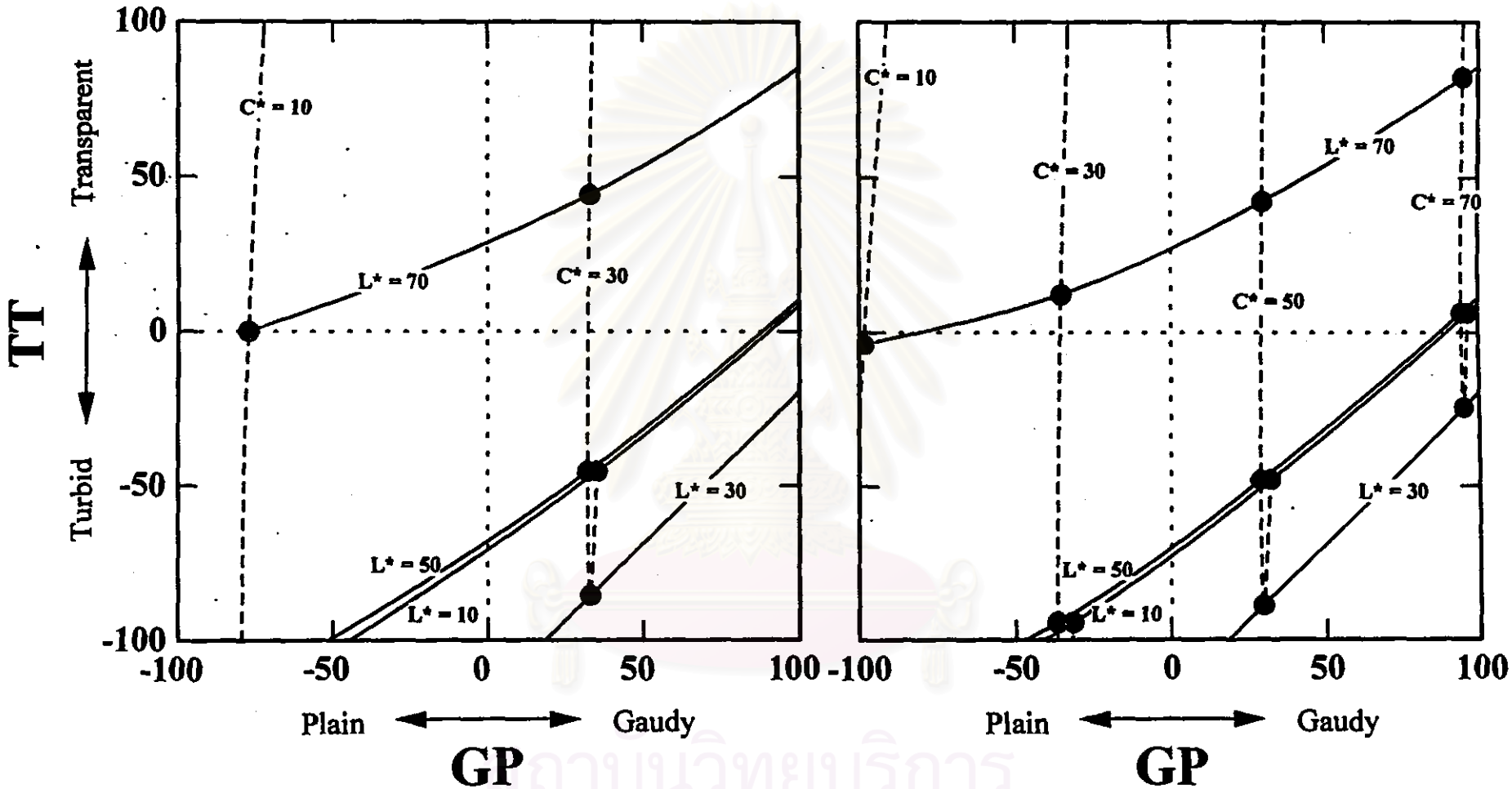


Figure 4-124 The projection of CIELAB color system on GP-TT color perception diagram: (a) h=270, (b) h=90

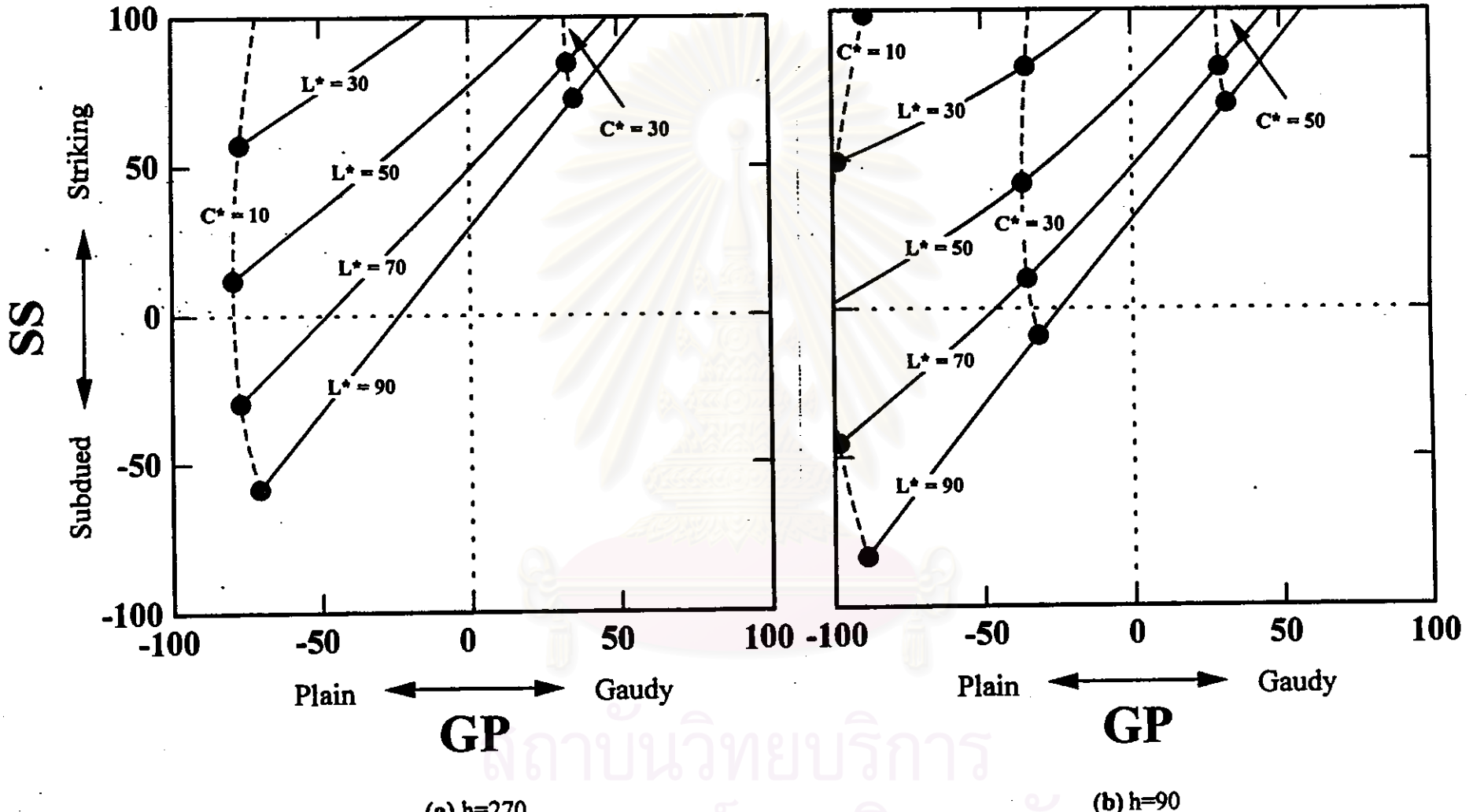


Figure 4-125 The projection of CIELAB color system on GP-SS color perception diagram: (a) h=270, (b) h=90

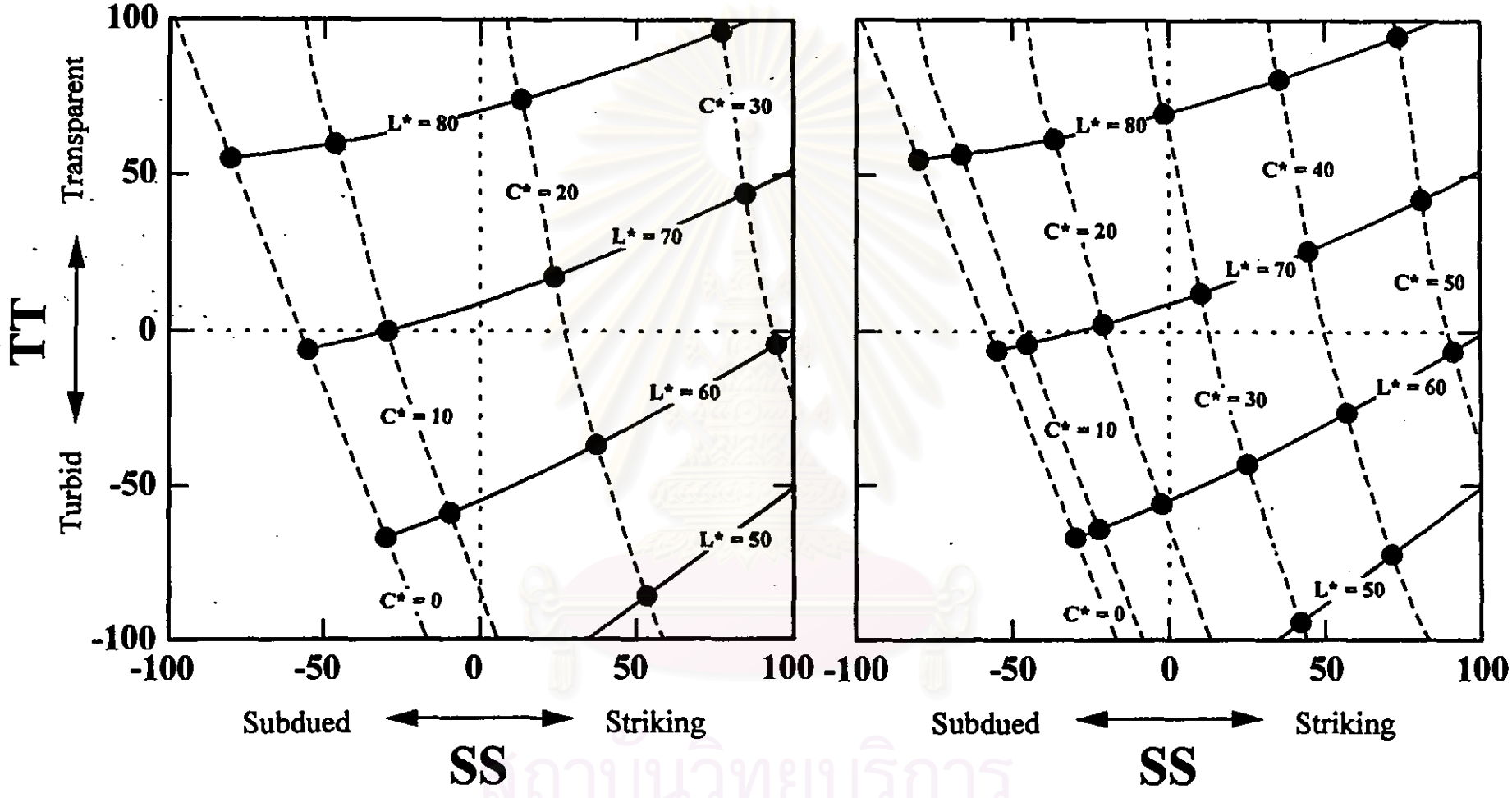


Figure 4-126 The projection of CIELAB color system on SS-TT color perception diagram: (a) h=270, (b) h=90