

SHADE MATCHING BY DENTAL STUDENTS

Sheldon Winkler, DDS
 Kenneth G. Boberick, DMD
 Kasia S. Weitz, DMD
 Isaac Datikashvili, DMD
 Robert Wood, DDS

KEY WORDS

Shade selection
 Hue
 Chroma
 Value

Sheldon Winkler, DDS, is an adjunct professor of dentistry at Arizona School of Dentistry & Oral Health, 5850 East Still Circle, Mesa, AZ 85206-3618. He formerly served as professor and chairman of the Department of Prosthodontics at Temple University School of Dentistry. Address correspondence to Dr Winkler at swinkdent@cox.net.

Kenneth G. Boberick, DMD, is an associate professor and Robert Wood, DDS, is an assistant professor of Restorative Dentistry at Temple University School of Dentistry, Philadelphia, Pa.

Kasia S. Weitz, DMD, and Isaac Datikashvili, DMD, are recent graduates of Temple University School of Dentistry, Philadelphia, Pa.

Dental students achieved a high identification rate for darker shades (P14 and P24) on the Portrait IPN shade guide, which represent the highest chroma and lowest value in the grayish and reddish yellow hue groups. A high identification rate was also obtained for P32, representing the lowest chroma and highest value in the reddish gray hue group. The data suggest that dental students had the most difficulty determining the correct hue group for unmarked shade tabs. Incorrect responses tended to remain in the same value and chroma range but were selected in a different hue group.

INTRODUCTION

Research advances throughout the years have enabled dentists, in concert with skilled laboratory technicians, to fabricate esthetically pleasing and functional restorations. When handled properly, porcelains and resins in use today as veneering materials can reproduce the subtle gradations of color that are essential to duplicate the vitality of the natural dentition.

Success in shade selection is dependent upon accurate communication between the clinician and the dental laboratory technician. Factors such as coloration, staining, blending, and subtle morphological variations can be intelligently discussed only if both participants understand the language of color and the significance of hue, chroma, and value. Only then can the illusion of reality be obtained for the restoration in question.

Although it may not be possible to exactly duplicate the color of natural teeth, an illusion can be created that suggests and simulates it. To do this, it is necessary to borrow from both the impressionist and the camoufleur. The impressionist does not mix color on the palette to obtain his gradations. He or she stipples pure colors on the canvas in the form of dabs or dots in such a way that the eye fuses them to the desired effect when the paintings are examined at viewing distances. The camoufleur confuses the eye by color and line so as to cause the camouflaged object to merge with its surroundings and be difficult to detect.¹

No single tooth is of uniform color. All teeth are aggregates of a number of hues, and most have varying shadings of the same hue. Chroma is the strength or saturation of a hue, whereas value is the brilliance or dullness of a hue.

Dental education usually does not teach the fundamentals of



FIGURE 1. The Portrait IPN shade guide.

color science. The dental student and the clinician generally are not familiar with visual color analysis and, perhaps more important, are often unable to adequately describe coloration to the dental laboratory technician. If a student or clinician cannot discuss hue, chroma, and value with a laboratory technician, he or she is unable to supply the information necessary to create an esthetic restoration that harmonizes with the patient's remaining natural teeth.

The purpose of this investigation was to determine whether dental students were able to match unmarked resin tooth tabs with identical shade tabs on a popular commercial shade guide.

MATERIALS AND METHODS

The Portrait IPN shade guide (Dentsply International, York, Pa) (Figure 1) presents the practitioner with 16 Vita shades, 8 Bioform shades, and 2 bleached shades. Tabs designated "P" from 1 to 34 crossmatch to Vita shades A1 to D4. The shade guide is organized with the first level involving partition of the 16 Vita shades into 4 hue groups: A = reddish

brown, B = reddish yellow, C = grayish, and D = reddish gray. Within each hue group the shade tabs are organized with increasing chroma and decreasing value. The 8 Bioform shades are designated "P" shades from P59 to P81 and correlate to the original Bioform shades. Because of a close correlation, tabs P11 and B59 could have been considered as a single tab but were evaluated separately.

Senior and junior dental students at Temple University were presented with unmarked shade tabs and asked to match the tab against the shade guide. The results are shown in the Table.

The highest percentages of correct matching were recorded for tabs P24 (80%), P14 (78%), and P32 (76%). Tabs P24 and P14 represent the highest chroma and lowest value in the grayish and reddish yellow hue groups. Tab P32 represents the lowest chroma and highest value in the reddish gray hue group. Tab P1, which has the lowest chroma and the highest value in the reddish brown hue group, scored highest in that group, with 33% correct. The lowest scoring tab was P81 in the Bioform group, with 4% correct.

DISCUSSION

The pronounced scatter found in the data may reflect genuine similarities both between and within the Vita and Bioform shade tabs, or it may be a reflection of the inexperience of dental students in recognizing the subtle shade similarities and differences. Senior students averaged a mean of 7.2 correct as compared with 4.9 correct for the junior students, indicating experience may be a factor. No significant difference was noted between men (6.2) and women (6.5).

The data suggest that students had the most difficulty determining the correct hue group for the shade tab. Incorrect responses tended to remain in the same value and chroma range but were selected in a different hue group. The large amount of data scatter found in the Bioform range of the shade guide suggests that several of the shades are easily confused.

The data may suggest insight into the proper method used by students to select color according to the 3 dimensions of hue, value, and chroma. It has been debated whether students should begin shade selection with hue, value, or chroma. Preston and Bergen² recommend that students begin shade selection with a value (brightness) comparison. It should be noted whether the shade-guide tooth is higher or lower in value. The hue should be determined next. Natural teeth lie within the range of yellow-red to yellow. The last determination should be the relative saturation (chroma) of the pair being considered.

Ideally, shades should be selected in natural light. North sunlight at noon on a day with very little cloud cover is recommended. These conditions cannot

TABLE
Results of shade tab matching by dental students, with correct response (in percent) shown in bold

	a1p1	a2p2	a3p3	a3.5p3.5	a4p4	b1p1	b2p12	b3p13	b4p14	c1p21	c2p22	c3p23	c4p24	d2p32	d3p33	d4p34	p59	p62	p65	p66	p67	p69	p77	p81
a1p1	33																17	2						
a2p2		26	7			46				24	4			2	11		4	9						
a3p3		20	13				7				2			2	7		4	7	15	13	7	11	7	
a3.5p3.5				7				15			2			4	4	7		7	4	2	4	4	4	37
a4p4				30	13			7			4	13	2			2					9	2	9	7
b1p11	43					30				13							13							
b2p12							24			13				2	9	11		9	2	4	20	4		15
b3p13		9	9					24	2	2				7	11		26	11	4	2	2	13		2
b4p14								7	78	22				7		4	4							15
c1p21						4	20				26	30			9		26							2
c2p22						2				15							4							13
c3p23						20					2	24	9				4							2
c4p24						7							80	76										2
d2p32										2	9	9	2				7	2	24	9				4
d3p33						2	4			2	13	9		2	17	7	7	2	7		20			2
d4p34						4				4	4	9		2		4	28	20	15	11	13	4		4
p59	13					7	15			4	7	9					4	20	20	15	11			4
p62						2	4			4	4	4					2	4	13	4	13	4		4
p65						2	4			2	4	4					2	4	13	4	17	4	33	2
p66						2	9	13		2	4	2					2	2			17	20	11	2
p67						2	2	9		2	11	2					2	2			7	15	20	4
p69						4	4	15		2	7	9	2	2	4	4	7	9	7	9	11	15	20	4
p77	2					35		7									2	2			9	9	17	2
p81																					2	2	11	4

always be achieved. Tooth color will differ depending upon the light source and conditions. A good balanced light source should be used, with no intense distracting background coloration.

CONCLUSION

A high correct-identification response rate by dental students was recorded for the darker shades (P14 and P24) on the Portrait IPN shade guide, which represent the highest chroma and lowest value in the grayish and reddish yellow hue groups. A high correct-response rate was recorded for P32, representing the lowest chroma and highest value in the reddish gray hue group.

The data suggest that dental students had the most difficulty determining the correct hue group for unmarked shade tabs. Incorrect responses tended to remain in the same value and chroma range but were selected in a different hue group.

ACKNOWLEDGMENT

The authors would like to express their appreciation to Christopher R. Kennedy, PhD, of Dentsply International for providing hue, chroma, and value charts for all the teeth on the Portrait IPN shade guide. This study was supported by a grant from Myerson Tooth Company, Chicago, Illinois.

REFERENCES

1. Winkler S, Vernon HM. Coloring acrylic denture base resins. *J Prosthet Dent.* 1978;40:4-7.
2. Preston JD, Bergen SF. The science of color, part 1. In: Preston JD, Bergen SF, eds. *Color Science and Dental Art: A Self-Teaching Program.* St Louis, Mo: Mosby; 1980:3-10.