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.

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 confuse 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
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 Bergen 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
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.

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