Evaluation of visual and instrumental shade matching by dental students

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46th Meeting of the Continental European Division of the International Association for Dental Research (CED-IADR)

Introduction:

The color of natural teeth is a quite complex optical phenomenon. It depends on stratiform layers of enamel and dentin that absorb, reflect, transmit or refract incident light; the reflected light is the one transmitting to the brain the visual image of tooth color[1,2,3].

The colors are manifested by electromagnetic waves that can sensitize human retina. Waves producing stimuli through the colors are part of a band called the visible spectrum (380-760 nm), being perceptible to the human eye[4,5].

Color matching in dentistry can be perfomed by two methods: visual and instrumental[6,7].

Objectives:

To evaluate the ability of dental students in matching the tooth shade of three patients with increasing levels of difficulty and the influence of gender on shade matching quality.

The first null hypothesis is that there is no difference in color evaluation between visual and instrumental methods and the second null hypothesis is that there is no difference in color evaluation between gender.

Methods:

The color of central incisors and canines of three different patients, D1-complex case (Fig. 1), D2-intermediate case (Fig. 2) and D3–simple case (Fig. 3), was determined by the spectrophotometer Spectro-Shade Micro (MHT - Niederhasli, Switzerland) (Fig. 4a-e). Each student, in the 4th and 5th grades of a Dental Medicine Faculty, selected the closest match for each tooth using the Vita classical shade guide (VITAPAN®classical, Vita Zahnfabrik - Bad Säckingen, Germany) (Fig. 5a-c).

1. Case Selection

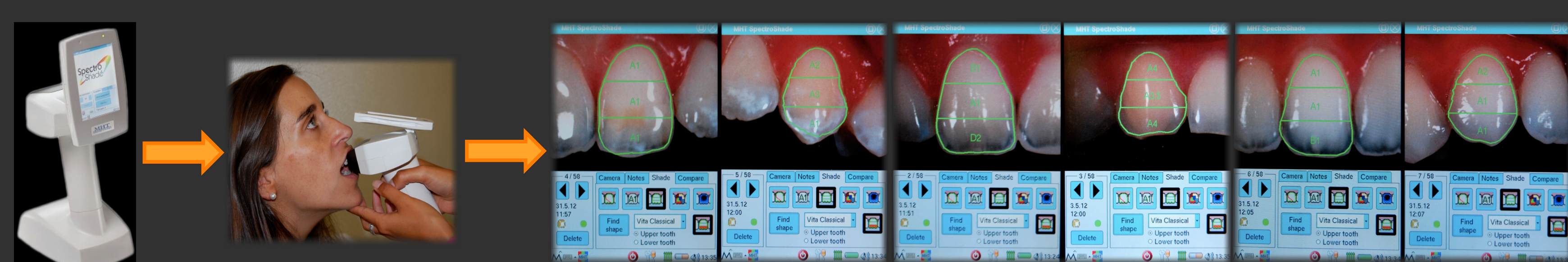
Fig. 1 Fig. 2 Fig. 3

2. Instrumental Method
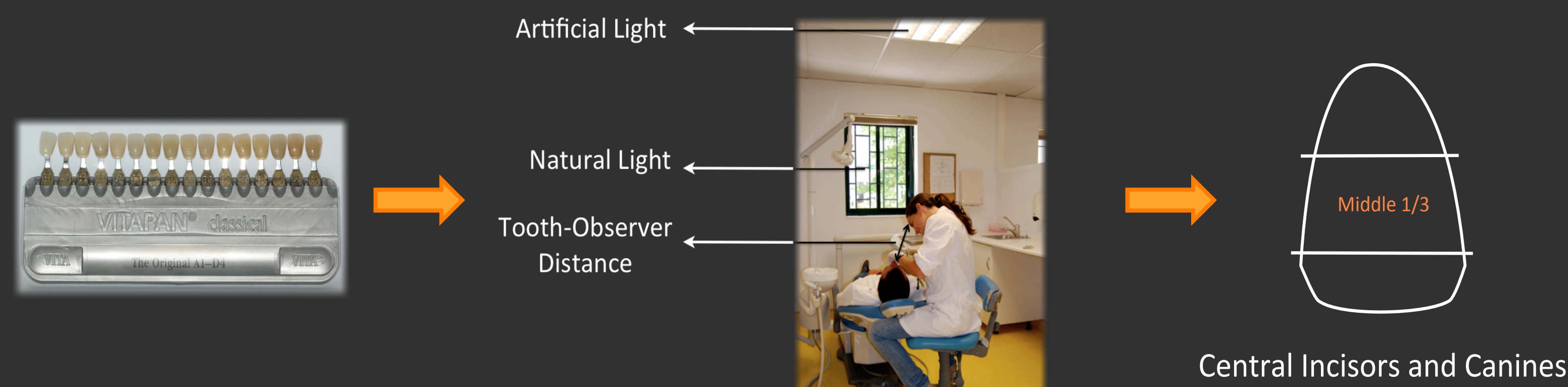

Fig. 4a Fig. 4b Fig. 4c Fig. 4d Fig. 4e

A1 A3 A1 A3,5 A1 A1

3. Visual Method

Artificial Light
Natural Light
Tooth-Observer Distance

Fig. 5a Fig. 5b Fig. 5c

Middle 1/3
Central Incisors and Canines

Students were also asked: "What was the tooth that they felt more difficult for shade evaluation?" and "Which factors had most influenced on shade evaluation?".

After data collection, statistical analysis was performed with the software SPSS 18.0 for Windows (SPSS Inc., Chicago, IL, USA). The Fisher exact test was used to evaluate the correspondence between the two methods, in the two teeth of each patient, for each of the two groups (sex and year). The Chi-Square test was used for evaluation, in each patient, by sex and year, of the teeth that generated more difficulty in color determination as well as the factors that influenced its determination. The level of significance was set at 5%.

Conclusions:

Shade evaluation with the visual shade guide was consistent with the spectrophotometric shade analysis. No statistically significant differences were detected between the two methods (the first null hypothesis was accepted), as a function of gender and dental students grade (the second null hypothesis was accepted). However, the perception of color match can be affected by light conditions, tooth shade guide, tooth characteristics and distance.
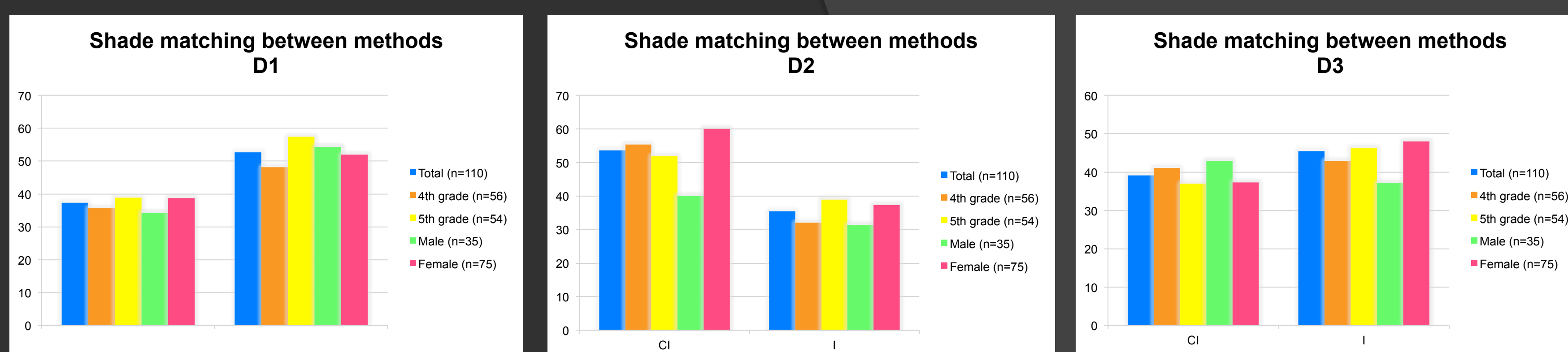
Results:

Fig. 6a Fig. 6b Fig. 6c

Inferential statistics analysis was performed (at a 5% significance level) in order to compare the results of color evaluation by the two methods, as a function of gender and dental students grade (Fig. 6a-c). No significant differences were found (Fischer's Exact test, p>0.05).
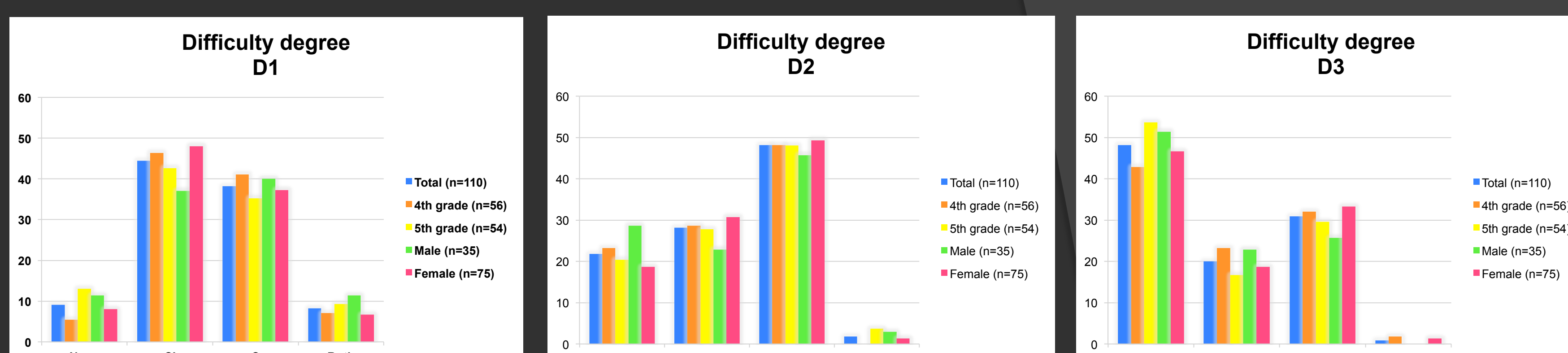

Fig. 7a Fig. 7b Fig. 7c

The difficulty degree in color evaluation among the three different patients was also compared and no significant differences were found (Chi-square test, p>0.05) (Fig. 7a-c).
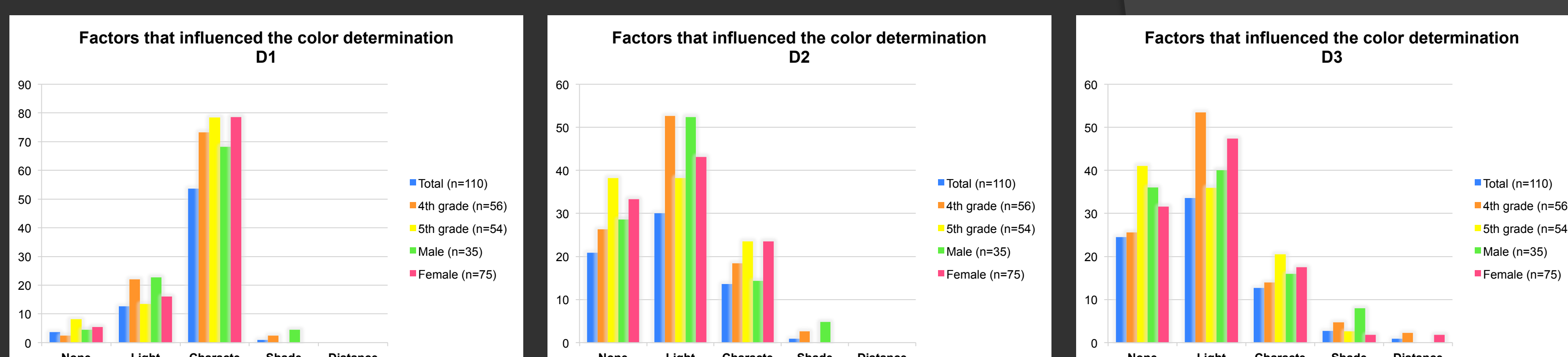

Fig. 8a Fig. 8b Fig. 8c

Students mentioned the characteristics of the teeth in the complex case as the factors that influenced the color determination, (Fig. 8a). For the intermediate and simple cases, in general, they mentioned the light (Fig. 8b-c).

Discussion

Visual and instrumental shade matching:

- No statistically significant differences between methods which is in accordance to other authors[6]. Nevertheless other studies found the instrumental method more precise [8,9,10].

Color determination between gender:

- No statistical differences between men and women, which is in accordance to other studies [11, 12, 13]. Other authors found that women tend to be more consistent in color perception than men and that gender plays a very important role in color determination[14, 15, 16].

- Daltonism (color blindness) affects many men and this may be the explanation for having less perception in color determination than women[17]. In this study, in accordance to other authors, students with daltonism were excluded to avoid distortions[13].

Factors that influence color matching:

- There are no studies concerning the factors that influence color determination. Nevertheless, some authors refer different related items such as: a) teeth characteristics (surface brightness, position, thickness of enamel and dentin, presence of pigmentation, translucency, opacity, hydration/dehydration)[11, 15]; b) light (as natural and artificial light, the surrounding environment, the impact on the tooth surface, light quality, time of the day, mode of absorption and reflection by the tooth)[6, 11, 13, 15, 17]; and c) the shade guide used (related with clinical experience and the distance between observer-tooth that must be ≥ 30 cm)[2].

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