The role of personality traits in self-rated oral health and preferences for different types of flawed smiles

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SUMMARY Symmetric, aligned and luminous smiles are usually classified as 'beautiful' and aesthetic. However, smile perception is not strictly governed by standardised rules. Personal traits may influence the perception of non-ideal smiles. We aimed to determine the influence of personality traits in selfrated oral health and satisfaction and in the aesthetic preference for different strategically flawed smiles shown in photographs. Smiles with dark teeth, with uneven teeth, with lip asymmetry and dental asymmetry were ordered from 1 to 4 as a function of the degree of beauty by 548 participants, of which 50.7% were females with a mean age of 41.5 ± 17.6 years (range: 16–89 years). Self-assessment and oral satisfaction were recorded on a Likert scale. Personality was measured by means of the Big Five Inventory (extraversion, agreeableness. conscientiousness, neuroticism and openness), and the Life Orientation Test was used to measure optimism and pessimism. Of the four photographs imperfect smiles, with dental

Introduction

Physical appearance has traditionally been recognised as playing a key role in human social interactions (1), the lower one-third of the face (the smile) being the facial region with the highest impact on the perception of facial aesthetics (2). This is because the mouth plays a relevant role in the expression of emotions (3) Furthermore, it is increasingly recognised that the aesthetics of the mouth has a significant effect on the way people develop their first impressions of another asymmetry was the most highly assessed in 63% of the sample, and the worst was lip asymmetry, in 43.7% of the sample. Some personality traits (above all conscientiousness and openness) were significantly correlated with the position assigned to the photographs with dental and lip asymmetry or with misaligned teeth. The extraversion, agreeableness and openness traits were correlated with the self-perceptions of oral health and aesthetics of the participants. Dental asymmetry seems to be better tolerated than lip asymmetry. Personality traits are weakly but significantly correlated with the aesthetic preference and oral health values, conscientiousness and openness being the most relevant domains in this sense.

KEYWORDS: Big Five Inventory, personality traits, smile perception, symmetry, tooth colour, flawed smiles

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person regarding physical attractiveness, professional success, intelligence and happiness (4).

For decades, photographs have been used to evaluate whether people find different anterior teeth traits aesthetically pleasing (5) and to evaluate the different aesthetic factors in a smile (6) or to determine the prevalence of subjects who show the gingival tissue of their anterior teeth during a natural smile (7). There are two types of smiles described in the literature, that is posed and spontaneous (8). The posed smile is a social form of smile, which can be easily repeated (8). Many investigators have tried to discover the secret of beautiful smiles (9) by assessing objective parameters in a person's natural dentition. In this sense, it has been reported that colour lightness is the strongest predictor of the attractiveness of a smile (4). Also, the smile line (9) (the curve which passes through the incisal margins of the maxillary incisors and canines) is more aesthetic when it is convex than when it is concave (9–12). During smiling, the upper lip position should expose the maxillary central incisors from three quarters of the clinical crown to 2 mm of gingival display; the so-called gingival smile being more common among females (8, 13). The symmetry of tooth alignment and lip curves seems to be a key aspect in the attractiveness of a smile (14). In sum, a beautiful smile is a multifactorial construct that should show at least white and well-aligned teeth, distributed and framed symmetrically and harmoniously with the gingiva and lips (15).

Almost all cultures seem to have defined aesthetic criteria (16), and several findings suggest that the perception of beauty may be innate and, additionally, universal or cross-cultural (17). However, it is also plausible that aesthetics might depend on the eve of the beholder, because aesthetics is an individual construct and each person has a particular way of selfassessing his/her own appearance and the beauty of others (9, 18). Some sociodemographic factors of the beholder (such age, gender or social class) may also impinge on the perception of aesthetics (19). Despite the above, however, the influence of the personality traits of the observer (such as extraversion, agreeableness, conscientiousness, neuroticism and openness) on self-rated oral health values and aesthetic preferences has not yet been assessed. Personality is conceived as a multidimensional psychological construct that forms the individual's distinctive character and governs his/her conduct in life. Thus, this construct seems to be potentially able to modulate aesthetic perceptions and oral health values.

Here, our aim was to determine the influence of personality traits on self-rated oral health or satisfaction and on aesthetic preferences for different flawed smiles, shown in photographs.

Material and methods

This cross-sectional study was performed on 548 volunteers with ages between 18 and 89 years. All were Spanish nationals with no visual or cognitive alterations, and none had any links to the dental profession (there were no students of odontology, dental prosthetists and dentists). All agreed to participate in the research and gave written consent, approved by the Bioethics Committee of the University of Salamanca. These 548 participants rated 4 flawed smiles shown in photographs (with dark teeth, with uneven teeth, with lip asymmetry and with dental asymmetry) giving a score from 1 to 4 as a function of the degree of beauty.

Considering that the aesthetics of a smile depends mainly on tooth alignment, tooth colour, tooth-gum symmetry and lip shape, we made a strategic selection of 4 natural-looking smiles of young women in which one of the factors was clearly altered (Fig. 1). We considered tooth-gum and lip asymmetries when the shapes of such soft tissues were not similarly distributed regarding the midline axis. In the same sense, we considered tooth colour to be poor when it was yellowed, and the term misalignment was used to refer to when irregularities, either rotations out of, or displacements, from normal alignment were observed.

A digital colour photograph (14 Mb) was taken of the mouths of four females smiling in a way that exposed their apparently natural-looking smile using a tripod-supported Canon EOS-400 digital camera without flash in a naturally lit environment. These original photographs were manipulated digitally to show a slight top lip hair shadow, imitating the characteristics of a young male's smile (Fig. 2).

We laser-printed 64 copies of each of these composite photographs (32 composite 'female' photographs and 32 composite 'male' photographs) on photographic paper using a 30×40 cm portrait format. The photographs were distributed in closed envelopes in the last lecture before the Christmas holidays to 32 undergraduate students studying in the fourth year of Dentistry at the University of Salamanca. The 548 participants were initially told that the purpose of the study was to explore 'the smiles and personality traits of people by means of photographs'. The 32 students registered in the subject 'Dental and Maxillo-facial prostheses II' (School of Dentistry, University of Salamanca, Spain) were trained to fill in the scales of at least 15 relatives, friends or companions during the holidays. Each student was given the two sets of composed photographs ('male' and 'female' smiles) in a different order. The 548 interviewees were unaware Fig. 1. Selected photographs of flawed smiles of women shown to the participants in this study: (a): tooth-gum symmetry, lip symmetry, correct tooth alignment and yellowish colour; (b): light tooth colour, tooth alignment, lip symmetry and tooth-gum asymmetry; (c): light tooth colour, tooth-gum symmetry. correct alignment and lip asymmetry, and (d): light tooth colour, lip symmetry, tooth-gum symmetry and poor tooth alignment in the area of the canines.

Fig. 2. Composed photographs of 'male' flawed smiles shown to the participants in this study. (a) Light tooth colour, lip symmetry, toothgum symmetry and poor tooth alignment in the area of the canines. (b) Light tooth colour, tooth-gum symmetry, correct alignment and lip asymmetry. (c) Light tooth colour, tooth alignment, lip symmetry and tooth-gum asymmetry. (d) tooth-gum symmetry, lip symmetry, correct tooth alignment and yellowish colour.





of the true aims of the study. Data collection was carried out during the Christmas holiday period when the students were not in contact with one another. Thus, each student collected data in different places, and indeed, a large part of the Spanish territory was covered: Madrid, Tenerife, Salamanca, Vitoria, Barcelona, Soria, Cáceres, Vigo, Toledo, Segovia, Badajoz, Valladolid, Burgos, León, Valencia, Zamora, Palencia, Ciudad Real, Ávila, Gran Canaria, Ponferrada, Fuerteventura, Zaragoza, Sevilla, Granada and Gijón.

Below we describe the rigorous systematics in the order of data acquisition. First, the participants were

asked to order by preferences, from 1 to 4, the women's smiles they liked the most. In this sense, 1 corresponded to the most beautiful smile and 4 to the least agreeable smile. The second part of the question-naire contained demographic and behavioural variables related to oral habits: age, gender, place of residence, smoking habits, frequency of brushing and visits to the dentist. Then, the participants answered general questions and personal questions related to facial and dental aesthetics. We also asked questions about personality according to the Big Five Inventory (BFI) of Benet & John (20), which consists of 44 items

measuring five trait dimensions of personality extraversion (eight items), agreeableness (nine items), conscientiousness (nine items), neuroticism (eight items) and openness to experience (nine items) - and uses a 5-point Likert scale from 1 = 'strongly disagree' to5 = 'strongly agree'. It should be noted that some of the items were strategically formulated backwards to control the consistency of the participants (response bias). Accordingly, in the calculation of the total scores of the 5 dimensions, these items were also reversed so that there would be proportionality in the score and the personality domains. Extraversion can be defined as being focused on the outside world. Extraverts like to be in other people's company. Because they are focused on the outside world, they are more sociable, more easy-going and adapt to change faster. It could be argued that they would be more likely to trust e-retailers, especially with respect to information practices. Neuroticism is characterised by emotional instability, pessimism and low self-esteem. People high in neuroticism often perceive that they have an unfavourable position in transaction processes. They feel that they have no control. People scoring high on agreeableness have positive beliefs about others and appreciate their values and convictions. In contrast, people who score low on agreeableness have little respect for other's interests and well-being and are less concerned with social norms. People scoring high on conscientiousness are thought to be responsible, dutiful and trustworthy. In addition, they are considered to be more serious and cautious in making decisions. People who score low on conscientiousness will be more likely to trust other people. Openness to experience is characterised by open-mindedness. People scoring high on openness are more likely to make broad-minded decisions, in contrast to people who score low on it who tend to make more conservative decisions. More openness leads to more willingness to embrace new concepts and be less troubled by new situations and experiences. Thus, people with a high openness to experience are more likely to trust others.

The fourth part of the questionnaire addressed the degree of optimism/pessimism of the participants. The Life Orientation Test (21) is a 12-item scale that was developed to assess individual differences in generalised *optimism* versus *pessimism*. This measure has been used in a good deal of research on the behavioural, affective and health consequences of the optimism/pessimism dimensions (22).

Finally, the participants were shown the 'men's smiles' photographs, in a different order from that previously shown.

Statistical analysis

Any questionnaire with more than two unanswered items was excluded from the study. As the major outcome variable was ordinal, coded from 1 to 4, we described the data distribution by expressing the number and percentage within each category, highlighting the mode (the most frequent category) in grey. Furthermore, to compare the ordinal positions between two or more subgroups, we used nonparametric tests (the Mann-Whitney U-test or the Kruskal-Wallis test, respectively). In these situations, we chose the median value and the interquartile range (IQR) as parameters of the central tendency and dispersion of the data, respectively. The Wilcoxon signed rank test for related samples was also used to compare the ordinal position assigned to the flawed smiles, depending on the gender of the model in the photograph. The intra-class correlation coefficient (ICC) was used to measure the level of agreement between the ratings given to the same flawed smiles of both the 'male' and 'female' models. Spearman (r_s) correlation coefficients were calculated to quantify the linear relationship between several ordinal variables. A forward stepwise logistic regression analysis was performed to quantify the risk of being assigned to a poor ordinal score position (3-4) against a positive score (position 1-2), after the inclusion of several observer-related variables and picture-related variables. The Statistical Package for the Social Sciences v.20.* was used for the statistical analyses. The cut-off level for statistical significance was 0.05.

Results

As shown in Table 1, the study sample comprised 548 subjects, 50.7% of them women, who were living mainly in urban zones (67.3%) and had a mean age of 41.5 ± 17.6 years (range 16-89 years). In terms of behaviour, 75.7% of the sample brushed their teeth at least twice a day, and 73% were non-smokers.

*SPSS Inc., Chicago, IL, USA.

	N	%
Age ranges		
<35 years	238	43.4
35–44 years	63	11.5
45–64 years	193	35.2
≥65 years	54	9.9
Gender		
Female	278	50.7
Male	270	49.3
Place of residence		
Urban	369	67.3
Rural	179	32.7
Smoking habits		
Non-smokers	400	73
Smokers 1–9 cig per day	47	8.6
Smokers 10–15 cig per day	73	13.3
Smokers >15 cig per day	28	5.1
Dental attendance		
Check-up visits	294	53.6
Problem-based visits	254	46.4
Brushing habits		
Once a day	133	24.3
≥Twice a day	415	75.7
*		

Table 1. Description of the sociodemographic and behavioural variables of the participants (n = 548)

Table 2. Perceptions about facial and dental attractiveness among participants (n = 548)

	Ν	%
General considerations		
Importance of the face in physical attractivene	ess?	
None	21	3.8
Fairly important	63	11.5
Very important	464	84.7
Which of the following facial elements has the	e greatest	weight
in facial attractiveness?		
Eyes	263	48
Lips	40	7.3
Teeth	169	30.8
Nose	68	12.4
Ears	8	1.5
Which is the main element in a beautiful smil	le?	
Tooth colour	127	23.2
Symmetry	175	31.9
Tooth Alignment	246	44.9
Is aesthetic perception a personal or a univers	al issue?	
Personal	331	60.4
Universal	152	27.7
Don't Know	65	11.9
Personal considerations		
Self-rated oral health		
Bad	178	32.5
Fair	163	29.7
Good	207	37.9
How satisfied are you with your own smile?		
Dissatisfied	75	13.7
Fairly satisfied	154	28.1
Satisfied	319	58.2
Which of the following smile-related elements	s would ye	ou like
to improve?		
Tooth shape	32	5.8
Tooth colour	212	38.7
Tooth position	141	25.7
Tooth size	36	6.6
No need for improvement	127	23.2
Self-rated satisfaction of participants with thei	r own too	th
colour		
Dissatisfied	152	27.7
Fairly satisfied	147	26.8
Satisfied	249	45.4
Do you mask your smile when smiling?		
No	481	87.8
Yes, because of the shape of my teeth	8	1.5
Yes, because of the colour of my teeth	19	3.5
Yes, because of the alignment of my teeth	25	4.6
Yes, because of the size of my teeth	6	1.1
Yes, but because of other reasons	9	1.6

the Big Five Personality dimensions and for the *optimism/pessimism* domains. The results are shown in Fig. 3. *Openness* (34; IQR = 8), *agreeableness* (33;

They were attending the dental office for problem-related reasons (46.4%).

The Table 2 shows the general considerations about facial and dental aesthetics. 84.7% of the participants considered that the face was an important element in the physical attractiveness of a person and 48% believed that the eyes were the most important part of facial attractiveness, followed by 30.8% who stated that it was the mouth. 7.3% gave the most importance to the lips. The main element for a smile to be considered beautiful was tooth alignment (44.9%), followed by tooth symmetry (31.9%) and finally tooth colour (23.2%). According to 60.4% of the sample, aesthetic perception is a universal issue. Table 2 also shows personal considerations: self -rated oral health was good in 37.9%; 58.2% were satisfied with their own smile, and 38.7% of the sample wished to improve their smiles by changing their tooth colour. By contrast, 45.4% of the participants were satisfied with their tooth colour and 87% did not mask their teeth when smiling.

From the individuals' ratings on the BFI and LOT items, the median value and the interquartile range (median; IQR) of the score were calculated for each of



Fig. 3. Box-plot of the summary scores of the Big Five Inventory domains and the Life Orientation Test.

IQR = 7) and *conscientiousness* (32; IQR = 7) had the highest median scores, whereas the median score for *extraversion* (24; IQR = 7) was decreased and *neuroticism* had the lowest median score (21; IQR = 8). Regarding the LOT domains, the median summary scores and the IQR were identical, that is *optimism* (13; IQR = 3) and *pessimism* (13; IQR = 3), pointing to a balance between these antagonistic dimensions. Low correlations were detected for the five dimensions of personality. This is a good indicator of the independence of these personality dimensions.

The distribution of the ordinal positions of the different flawed smiles is depicted in Table 3. In general, the most pleasing smile was the one with dental asymmetry, in which more than 60% of the respondents gave the first position to both the masculine and feminine versions of the photographs. By contrast, the least pleasant smile was the one flawed with lip asymmetry. The darkened and misaligned smiles were assigned to middle positions, the best rates being given to the 'female' photographs than for the 'male' photographs. The Wilcoxon signed rank test revealed that the positions assigned to darkened smiles were significantly worse in the 'male' than in the 'female' smiles (P < 0.01).

The cross-tabulation across several sociodemographic traits revealed that there were no significant differences in the distribution of the ordinal positions regarding gender, age or place of residence of the observers. However, regarding behavioural traits, the subjects attending a dental office regularly and those who brushed their teeth more often assigned a significantly better position to the darkened smiles in 'males' than in their counterparts. In fact, the most common position assigned to darkened smiles in 'males' was ranked lower by subjects who brushed their teeth once a day than for subjects whose brushing habits were more frequent. Conversely the women showing misaligned smiles were perceived as significantly more aesthetic by subjects attending a dentist's office when problems arise than their counterparts.

Focusing on the influence of the gender of the photographed models in the ordinal positions, we observed that most participants gave an identical position to the 'males' and 'females' in the misaligned smile ($57\cdot1\%$), the dental-asymmetric smile ($66\cdot2\%$) and the lip-asymmetric smile (58%). However, for darkened smiles, the photographs of 'males' were in a poorer position than 'females' in $42\cdot9\%$ of subjects and were only rated identical to 'females' in $24\cdot8\%$. The 'male' asymmetric smile ($64\cdot1\%$) and the 'female' asymmetric smiles ($62\cdot6\%$) were the most attractive smiles, whereas the least pleasing smiles were 'male' lip asymmetry ($41\cdot8\%$) and 'female' lip asymmetry ($45\cdot6\%$).

Furthermore, using the intra-class correlation coefficient (ICC) as a measure of the intra-subject agreement between the ratings given to the same flawed smiles of both the 'male' and 'female' models, we

Darkened		Misali	Misaligned		Dental asymm	etry	Lip asymmetry		
	Male*	Female*	Male*		Female*	Male	Female	Male	Female
	n (%)	n (%)	n (%)		n (%)	n (%)	n (%)	n (%)	n (%)
Positic	'n								
1	76 (13.9)	90 (16.4)	77 (]	$(4 \cdot 1)$	80 (14.6)	351 (64.1)	343 (62.6)	35 (6.4)	35 (6.4)
2	159 (29.0)	187 (34.1)	173 (3	31.6)	171 (31.2)	121 (22.1)	122 (22.3)	92 (16.8)	70 (12.8)
3	152 (27.7)	172 (31.4)	175 (3	31.9)	129 (23.5)	35 (6.4)	55 (10.0)	192 (35.0)	193 (35.2)
4	161 (29.4)	99 (18.1)	123 (2	22.4)	168 (30.7)	41 (7.5)	28 (5.1)	229 (41.8)	250 (45.6)
		Median	Median	Media	n Mediar	Median	Median	Median	Median
		(IQK)	(IQK)	(IQK)	(IQK)	(IQR)	(IQK)	(IQK)	(IQK)
All		3 (2)	2 (1)	3 (1)	3 (2)	1 (2)	1 (1)	3 (1)	3 (1)
Gende	er								
Fem	ales	3 (2)	2 (1)	3 (1)	3 (2)	1 (1)	1 (1)	3 (1)	3 (1)
Mal	es	3 (2)	2 (1)	3 (1)	3 (2)	1 (1)	1 (1)	3 (1)	3 (1)
Age gi	coups								
<35	years	3 (2)	2 (1)	3 (1)	3 (2)	1 (1)	1 (1)	3 (1)	3 (1)
35-4	44 years	3 (2)	2 (1)	3 (2)	3 (2)	1 (1)	1 (1)	3 (2)	4 (1)
45-6	64 years	3 (2)	3 (1)	3 (1)	3 (2)	1 (1)	1 (1)	3 (1.5)	3 (1)
≥65	years	2 (1.3)	2.5(1)	3 (1)	3 (1)	1 (1)	1 (1)	4 (1)	3.5 (1.3)
Reside	ence								
Urba	an	3 (2)	2 (1)	3 (1)	3 (2)	1 (1)	1 (1)	3 (1)	3 (1)
Rur	al	3 (2)	2 (1)	3 (1)	3 (2)	1 (1)	1 (1)	3 (1)	3 (1)
Smoki	ng								
Smo	okers	3 (2)	2 (1)	3 (2)	3 (2)	1 (1)	1 (1)	3 (1)	3 (1)
Non	-smokers	3 (2)	2.5(1)	3 (1)	3 (2)	1 (1)	1 (1)	3 (1)	3 (1)
Denta	l attendance								
Che	ck-up	3 (1) [†]	2 (1)	3 (2)	3 (2)	1 (1)	1 (1)	3 (1)	3 (1)
Prob	olems	3 (2) [†]	3 (1)	3 (1)	2.5 (2)	1 (1)	1 (1)	3 (1)	3.5 (1)
Brush	ing habits								
Onc	e a day	3 (2) [†]	2 (1)	2 (1)	3 (2)	1 (1)	1 (1)	3 (1)	3 (1)
≥Tw	rice a day	3 (2) [†]	2 (1)	3 (1)	3 (2)	1 (1)	1 (1)	3 (1)	3 (1)

Table 3. Ordinal position of the different flawed smiles in the whole sample (n = 548) and median (IQR) deviation according to the different sociodemographic traits. The most common position (mode) is highlighted in grey

*Significant differences between genders regarding the flawed smiles after the Wilcoxon signed rank test for related samples. [†]Significant difference after the Mann–Whitney *U*-test or the Kruskal–Wallis test (P < 0.05) between the sociodemographic and behavioural subgroups.

observed a moderate agreement for the misaligned smiles (ICC = 0.74; P < 0.01), tooth asymmetry (ICC = 0.66; P < 0.01) and lip symmetry (ICC = 0.62; P < 0.01). However, the agreement about darkened smiles seemed to be the result of chance (ICC = -0.18; P = 0.98).

The linear relationship between the personality traits and the ordinal score for the different flawed smiles was very weak (Table 4). However, some of these correlations were significant, such as the negative association between *openness* and misaligned smiles in 'males' and 'females', and the negative correlation between *conscientiousness* and tooth asymme-

try in 'female' smiles and the positive correlation with lip asymmetry in 'females'. Also, *pessimism* was inversely correlated with misaligned smiles in 'females' but was correlated with lip asymmetry in both 'males' and 'females'. Although small in magnitude, all the correlations highlighted in grey were statistically significant. The darkened smiles were not correlated with any of the personality traits assessed. Table 5 shows that the scores on *extraversion, agreeableness* and *openness* were significantly correlated with self-rated oral health and satisfaction with the smile and tooth colour. By contrast, *neuroticism* was inversely correlated with these oral health perceptions. This means

	Darkened		Misaligned		Dental asymmetry		Lip asymmetry	
	Male	Female	Male	Female	Male	Female	Male	Female
Extraversion	0.07	0.02	-0.03	-0.06	0.04	0.05	-0.04	0.01
Agreeableness	0.03	0.00	-0.02	-0.03	-0.07	-0.02	0.06	0.07
Conscientiousness	0.0	0.0	-0.01	-0.04	-0.03	-0.11*	0.02	0.09*
Neuroticism	0.03	-0.03	0.05	0.02	0.08	0.02	0.07	-0.03
Openness	0.02	0.07	-0.09*	-0.10*	0.05	0.03	0.03	0.05
Optimism	0.04	0.01	0.0	0.01	0.04	-0.02	0.01	-0.03
Pessimism	0.05	0.07	-0.01	-0.10*	-0.04	-0.04	0.10*	0.09*

Table 4. Spearmancorrelationbetween personality traits and theordinal position of the differentflawed smiles in 'males' and'females'

*Significant Spearman correlation coefficients (P < 0.05).

	Importance of the mouth in facial aesthetic s	Self-rated oral health	Satisfaction with smile	Satisfaction with tooth colour
Extraversion	0.07	0.17**	0.13**	0.09*
Agreeableness	-0.04	0.10*	0.10*	0.11**
Conscientiousness	-0.05	0.07	0.05	0.09*
Neuroticism	0.07	-0.12**	-0.13**	-0.10*
Openness	0.08	0.12*	0.15**	0.09*
Optimism	0.09*	-0.04	-0.01	-0.08
Pessimism	0.01	-0.05	0.02	0.03

Table 5. Correlation between personality traits and several perceptions or self-assessments in the whole sample (n = 548)

*Significant	Spearman	correlation	coefficients	(P <	0.05)	
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**Significant Spearman correlation coefficients (P < 0.01).

Table 6. Forward stepwise logistic regression for predicting the risk of a flawed smile being assigned a poor ordinal score (3–4 position) against a positive score (1–2 position) after the inclusion of several observer-related variables and picture-related variables

							OR-95%CI	
	В	SE	Wald	df	P-value	OR	Lower	Upper
Types of flawed smile			748.841	3	0.000			
Misaligned vs. colour	0.040	0.09	0.22	1	0.637	1.04	0.88	1.23
Tooth asymmetry vs. colour	-1.905	0.11	329.376	1	0.000	0.15	0.12	0.18
Lip asymmetry vs. colour	1.183	0.10	153-298	1	0.000	3.27	2.71	3.94
Constant (darkened colour)	0.132	0.06	4.723	1	0.030	1.141		

that the higher the score on *neuroticism*, the poorer the ratings given to oral health and satisfaction with the smile and colour. *Optimism* was significantly and directly correlated with the importance of the mouth in facial aesthetics. This implies that the higher the *optimism*, the greater the importance is given to the mouth regarding facial aesthetics. However, no significant correlations were observed for *pessimism*.

After the inclusion of several observer-related variables and picture-related variables in a logistic regression model for predicting the risk of the flawed smile being assigned a poor position (3rd or 4th positions), we found that the type of flawed smile was the only significant predictor (Table 6). The observer-related variables included were age, gender, residence, smoking habits, dental attendance pattern, brushing habits, self-rated oral health, the importance of the mouth in facial aesthetics, self-reported satisfaction with the smile and with tooth colour. The BFI and LOT domain scores were also included as potential predictors or confounders. The picture-related variables included in the model were gender and the type of

study were flawed heterogeneously. Accordingly, it is

possible that some of the stereotyped defects (dark-

ened teeth, tooth asymmetry, lip asymmetry and

misalignment) might stand out more than others,

flawed smiles. In sum, taking the photograph with darkened smile as a reference, the odds ratio (OR) of being given a poor ordinal score was 1.14, but this risk increased significantly when lip asymmetry was shown in the picture (OR: 2.7-3.9). By contrast, it was significantly reduced when the asymmetry affected the teeth (OR: 0.12-0.18). No significant differences were found between misaligned or darkened teeth regarding the risk of being rated with poor ordinal positions.

Discussion

To improve the attractiveness of their patients' smiles, dentists need to carry out a comprehensive smile assessment when planning treatment (23, 24). They must be careful about imposing their own beauty norms on patients. Thus, the type and degree of deviation from the norm and the opinion of the patient must be taken into consideration. In this sense, it is recommendable to be familiar with the aesthetic parameters best tolerated by the general population when an optimum result is not possible, as well as the influence of personality traits in aesthetic perception. By means of photographs of smiles, clinicians can identify and analyse the relationships between the teeth and adjacent soft tissue (8, 25). Using smile photographs, this cross-sectional study aimed to assess the influence of the personality traits of the observer on aesthetic preferences for different flawed smiles of men and women and on oral health values. Our sample comprised a broad age spectrum including young people, adults and elderly persons (Table 1) from different regions of Spain because the students collected all the data from their relatives, friends and/or acquaintances during the Christmas holidays. This was performed to enrich the sociodemographic spectrum of the sample.

Nevertheless, given that this was a cross-sectional study, no causal relationship can be inferred, and we have accepted the most plausible direction of the significant associations reported here, although at the same time we are aware that these observations could never be supported by the study design.

In agreement with several authors (15, 26), we consider that the main aesthetic parameters in attractive smiles should be whiteness, good tooth alignment and a symmetrical arrangement of the teeth and lips. However, the stereotyped smiles selected for this such that this heterogeneous distribution of factors could govern the response given by the participants. Moreover, in some photographs, it was possible to detect several aesthetic flaws at the same time (Figs 1 and 2). However, we refrained from manipulating a standard smile, which would have allowed us to alter the four parameters studied independently, because there is no universal beauty standard for smiles, and also because we wished to analyse the effect of different, apparently healthy natural-looking smiles. Future studies should address the effect of digital manipulation on the same natural smile. The only digital manipulation performed in the present study was to alter the colour of the skin of the top lip in order to show an incipient but subtle growth of facial hair to represent the same smiles but with a more 'virile' aspect. This was performed because there is evidence that the sex of the model photographed may influence the attractiveness of the smile (27). As none of the participants had any professional

As none of the participants had any professional links to the field of dentistry, the scores obtained by the photographs could vary if the reference population were working in the field of odontology because it has been shown that laypersons and dental professionals have different perceptions of attractiveness when evaluating dental aesthetics (28–30).

Here, we report some results that are expressed by medians and modes because the participants had to order the photographs on a 1–4 basis according to the attractiveness of the smile portrayed. Another approach would have involved assigning quantitative evaluations on benchmarked scales to be able to work with means. However, this could have led us to find a greater number of ties on the scores and our aim was to assess the differential preferences for different types of clinically imperfect smiles.

The results obtained here show that the eyes and the teeth are the most important facial elements when determining facial aesthetics, alignment, symmetry and colour being the attributes most highly evaluated in a smile (Table 1). In social interactions, our attention is mainly directed towards the mouth and eyes of the face of the person speaking (31). Accordingly, future work should address the same goals using whole-face photographs, not only of the mouth (smile). Many famous people may have attractive smiles that are not technically perfect but that within the context of their faces may pass unnoticed and even prove to be peculiarly pleasing. However, with a view to exploring the factors inherent to the aesthetics of a smile and ensure that the smiles would not be contaminated by the surrounding facial features, we considered it appropriate to use the part of the face represented in the photographs provided here.

In the light of our results, it seems clear that in the 4 photographs of imperfect smiles, the most highly valued element is dental asymmetry and the worst one lip asymmetry (Table 3), in both men and women. In the most highly valued photograph, despite the asymmetry, there is probably a harmonious composition of the tooth and gum elements, together with an adequate colour of both elements (See Figs 1 and 2). By contrast, in the worst valued photograph, it is possible that tooth colour could prove to be les harmonious for the eyes of an observer not involved in the field of dentistry.

Regarding the influence of sociodemographic factors in the aesthetic perception of smiles, several authors have reported that the assessment of facial aesthetics depends on age, gender and demographic origin (32– 34). By contrast, our results suggest that the evaluation of different asymmetric smiles is similar as regards the gender and age of the participants (results not shown). Nevertheless, we did observe that some types of imperfect smiles were perceived as being more pleasing in men (misaligned) than in women (darkened smiles) and vice versa, although these discrepancies were not significant (Table 3).

Personality traits are assumed to be one of the components determining the perception of the attractiveness of dental appearance. Several rating instruments have been developed to measure the Big Five dimensions. The five-factor model is a useful framework to measure human personality (35), and it organises personality into five broad dimensions: extraversion, agreeableness, conscientiousness, neuroticism and openness to experience. The Big Five Inventory (BFI) was used to provide a short, flexible and easy-to-understand assessment of these five dimensions for studies focusing on the five broad dimensions instead of on individual facets (36). Both English and Spanish versions of the original BFI-44 have been shown to have good reliability and an acceptable factorial structure, together with convergent and discriminant validity (20). The ranges and median scores depicted in Fig. 3 are in consonance with those reported for adults in several cultures (37). Nevertheless, for a deeper examination of the personality traits, a larger inventory based on the same five domains, such us the NEO-PI-R (240 items), should have been used (38).

It is remarkable that so few studies have addressed any goal similar to the one studied here, although it seems feasible that in the self-assessment of health and in people's preferences in dental aesthetics, which are subjective evaluations of a physical trait with social repercussions, both personality traits and the way people cope with life could modulate such perceptions in a relevant way. Dong et al. (9) investigated correlations between personality factors and smile aesthetics in 60 Koreans. Personality traits were assessed by means of a Sixteen Personality Factor Questionnaire, and the aesthetics of social smiles were assessed by a panel. The study revealed significant correlations of smile attractiveness with extraversion and anxiety. Interestingly, only the personality traits of the female participants correlated significantly.

Our results partially support the findings of Dong et al. (9), because we found significant negative correlations between openness and misalignment for both the men and women, together with significant inverse correlations between conscientiousness and dental and lip asymmetries, both for the men and for the women. It seems logical that meticulous people who organise themselves efficiently (conscientiousness) would evaluate the lack of symmetry in lip shape negatively (Table 4). It is also plausible that greater openness would better tolerate the lack of tooth alignment in both men and women because this personality trait is related to artistic ability and the capacity to imagine and innovate. Accordingly, such people are possibly less likely to set up stereotypes based on the perfect composition of a smile. The degree of pessimism is also correlated with the lower scores on lip asymmetry and the better scores on tooth misalignment in women. It is possible that pessimism could decrease tolerance to evident flaws such as lip asymmetry.

In the present study, we observed that personality traits and self-assessments of health and aesthetics were significantly correlated in the expected direction. That is, the positive traits were correlated with positive assessments of health, whereas negative traits, such as neuroticism, were inversely correlated with these self-perceptions. In this sense, Van der Geld et al. (39) reported a connection between self-reported attractiveness and personality traits using the Dutch Personality Index, such as emotional stability, dominance and self-esteem. They investigated the self-perception of smile attractiveness and explored the role of the smile line and other aspects correlated with smile attractiveness and their influence on personality traits (37). The results revealed that the size of a person's teeth, the visibility of the teeth and upper lip position were critical factors in the self-perception of smile attractiveness (social dimension). Tooth colour and gingival display were critical factors in satisfaction with smile appearance (individual dimension). Participants who smiled with their teeth entirely displayed and some display of their gums (two to four millimetres) perceived their smile as the most aesthetic. Smiles with a disproportional gingival display or asymmetric arrangements were judged negatively and were correlated with the personality characteristics of neuroticism and self-esteem. In this study, none of the smiles studied showed more than 2 mm of gum and the photograph best valued both in the men and in the women, apart from having asymmetry in tooth size and arrangement, showed a different amount of gum on the right side than on the left one. However, this situation, which for a cosmetic dentist would not be very harmonious, seems to differ from the opinion of most of the population not working in the field of dentistry. It seems clear that the population at large has a different view of smile aesthetics (11, 19). Despite this, it is true that the asymmetric dental composition of this photograph is accompanied by fleshy lips with a pronounced smile line and long light-coloured teeth.

In the light of all the foregoing, it is necessary to acknowledge the complexity involved in the subjective evaluation of smiles because the beauty of a smile is a multidimensional construct whose dimensions are subjective and have a certain weight, which may be influenced by the personal situations of the observer. A smile can be described in terms of mathematical ratios and proportions but beauty cannot be calculated (40). Accordingly, it may be necessary to address smile aesthetics from the point of view of qualitative research in order to understand which factors the general public considers relevant in the aesthetics of a smile, bearing in mind that individual cultural characteristics and the perception of beauty are tightly linked (41). To summarise, we may conclude that dental asymmetry seems to be better tolerated than lip asymmetry. Personality traits are weak but are significantly correlated with aesthetic preference and oral health values, *conscientiousness* and *openness* being the most relevant domains in these perceptions.

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