The impact of priming on dentally induced social judgements: An experimental study

Sadhvi Shankar Subramanian [a,*], Koula Asimakopoulou [b], Tim Newton [b], Anita Chopra [c], Wen Luo [c], Andrew Joiner [c]

[a] King's College, London (Former MSc Student), University of Turku, Turku University Hospital and University of Turku, FI-20014, Turun Yliopsita, Finland
[b] King's College London, Floor 18, Tower Wing, Guy's Hospital, London SE1 9RW, United Kingdom
[c] Unilever Oral Care, Quarry Road East, Bebington, Wirral, CH63 3JW, UK.

ABSTRACT

Objective: To ascertain the effects of priming to consider tooth appearance (i.e. exposure to a 'tooth whitening television advert') versus control (a 'non-dental' television advert) on social judgements of tooth colour in a group of Caucasians.
Methods: Two groups of Caucasians randomly assigned to watch either a tooth-whitening advert (experimental, $N = 67$) or a bread advert (control, $N = 62$). All rated the measures of social perceptions: friendliness, popularity, social life, success, intelligence, graduation, introversion/extroversion, happiness, self-confidence, attractiveness, age-estimation and satisfaction, after watching either of the adverts and viewing three digitally modified photographs (Darkened, natural and whitened teeth) of different Caucasian adults (males and females) separately.
Results: There were no statistically significant differences for all the measures of social perception between the groups. Nevertheless, the questions that inquired about popularity, friendliness, success, intelligence, happiness, self-confidence, attractiveness and satisfaction were consistently rated higher for all three tooth shades in the experimental than the control groups. Further, within the experimental and control groups, higher ratings were given to the faces with whitened teeth than the natural and darkened teeth.
Conclusions: Priming has little impact on dentally induced social judgements as this study failed to demonstrate statistically significant differences. Nevertheless, both groups gave the highest subjective ratings for the faces with whitened teeth and the tooth-whitening advert group associated the faces in the photographs with higher subjective ratings than the non-dental advert group irrespective of the tooth shade. One reason for this could be the way media affects the psychological well-being.
Clinical significance statement: The almost universal exposure to idealised tooth appearance in the media may increase demand for aesthetic treatments. Standardising the colour of the tooth plays a huge impact and making individuals to view a tooth whitening advert just prior to a procedure might influence patient choices.

1. Introduction

Empirical evidence suggests that facial appearance is used as a guide to infer physical attractiveness [1]. Attractive individuals may enjoy social benefits as they are appraised to be more popular, sociable, friendly, happy and extraverted than their less attractive counterparts [2]. These standards of judgement may vary over time and across cultures [3,4]. An important component of facial appearance is the appearance of the whole mouth and teeth.

A desire to change one's dental appearance by electing to undergo

veneering and tooth whitening procedures may come from an unrealistic portrayal of celebrities in the media [5,6]. In line with this, psychological research that explored body satisfaction after media exposure has shown that mass media standards of beauty provoke body dissatisfaction [7,8]. Moreover, certain groups such as people with anorexia, pregnant women, young females and adolescents, are more vulnerable to idealised media images than others [9,10]. Pertaining to dentistry, an acute exposure to 'idealised' images negatively influences self-perception and creates facial dissatisfaction in males and females [11–13], though some of the studies have failed to establish a difference

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* Corresponding author.
E-mail address: sssubr@utu.fi (S.S. Subramanian).

in satisfaction after an exposure to 'ideal' and 'average' faces [14,15].

The influence of appearance of teeth on personality traits has been studied using digitally modified photographs of faces with visible teeth. Some obvious dental anomalies such as presence of caries, a more anterior location and extent of decay [16], tooth colour, visible orthodontic appliances [17], absence of anterior teeth [18] and dental malalignment [19] result in negative social judgements. Similarly, female participants ascribed adults with whiter than average teeth with higher social, psychological adjustment, relationship satisfaction and

intellectual ability than the same adults with non-whitened teeth [20, 21]. Collectively, various visible dental anomalies resulted in negative social judgements. However, there is no definite answer such as a psychological phenomenon to link this stereotypic behaviour. Therefore, this study sought to explore the effects of making individuals think about their own dental appearance on the social perceptions.

This study compared the impact of cueing two groups of Caucasian adults to either a tooth whitening advert or a non-dental advert on dentally induced social judgements. Further, the study aimed to explore
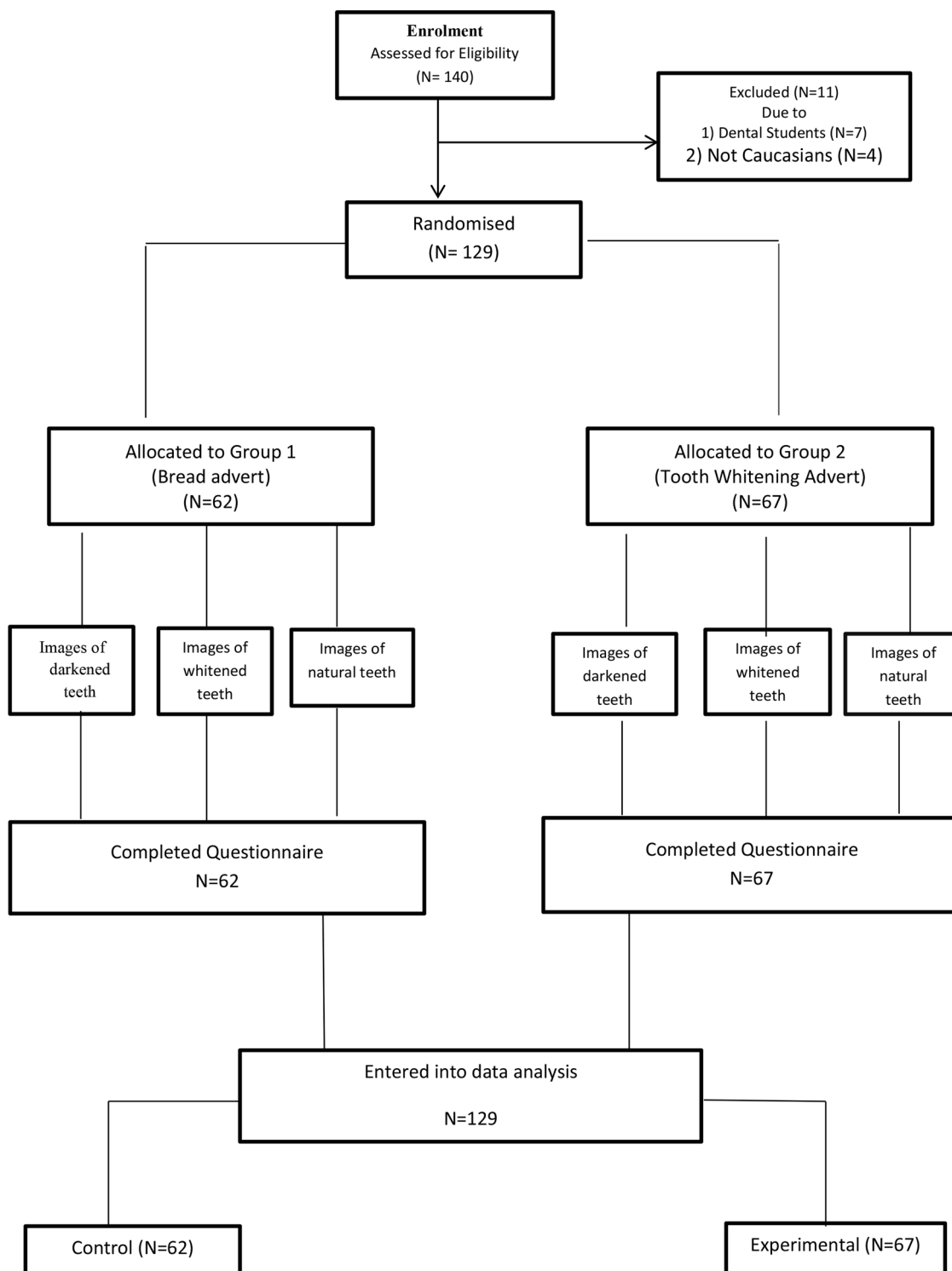

Fig. 1. Consort chart.

a relationship between the predictors (gender, group, tooth shade, shade*gender and shade*groups) and the subjective ratings of the personality traits and characteristics.

The hypotheses of the current study were

1 Individuals exposed to tooth whitening adverts will give higher ratings on all measures of social perception than those that are exposed to non-dental adverts, when viewing faces with whitened teeth.
2 Individuals exposed to tooth whitening adverts will give lower ratings on all measures of social perception than those that are exposed to non-dental adverts, when viewing faces with darkened teeth.
3 Individuals exposed to tooth whitening adverts will give equal ratings on all measures of social perception when compared with people who are exposed to non-dental adverts, when viewing faces with natural teeth.

2. Methods and materials

2.1. Study design

The experimental simulation compared the impact of exposure to tooth- whitening advert (experimental $N = 67$) versus non-dental advert (control $N = 62$) on social judgements of tooth colour, in two groups of randomly assigned Caucasian adults (Fig. 1). The actual purpose was disguised during the whole procedure by briefing the participants that the investigator explored 'the way we look at each other'. The Research Ethics panel approved the study. Randomisation using the computer-generated sequence did not result in equal numbers of participants in the control and the experimental groups.

Each participant watched either of the adverts and rated three digital images (Natural, Whitened, Darkened teeth) of three different Caucasian adults (males and females) separately. The order of display of these photographs was randomised. The ratings were acquired using a structured questionnaire used in previous studies and the questionnaire is provided in the supplementary file [20,16,20,22].

2.2. Participants

Participants in the control and experimental groups were members of staff and students of the university. They all identified their ethnicity as Caucasian. Dental students and staff were excluded as it was perceived that they will be aware of the true intention of the study. Informed consent was obtained from all the participants. The age range of the participants was 16 to 70 and the male: female ratio was 1:2 approximately. The age group of the images ranged from 20- 60 years, matching that of the participants.

2.3. Facial images and adverts

A total of 18 pictures of Caucasian males and females were captured under a uniform D65 standard daylight illumination with a mid-grey background. Images were all colour calibrated and standardised so that only the head and neck region was visible. Further, each face image was modified to all of the three conditions for the teeth area (darkened, natural and whitened), while other regions of the image (gingiva, lips, skin, hair etc.) remained the same. The whiteness difference with the natural dental appearance was 35 ΔWIO units (WIO is a whiteness index for teeth) [23], $\Delta L^* = +9$ and $\Delta b^* = -4.5$ for whitened dental appearance and $\Delta L^* = -9$ and $\Delta b^* = +4.5$ for darkened dental appearance. All images for all participants were displayed on the same monitor sized 23′′, calibrated using a spectroradiometer (brightness: 75%, contrast: 75%, sharpness: 50) and under a standardised viewing condition (indoor office fluorescent lighting and closed windows). The tooth whitening and the non-dental adverts were commonly used media adverts and were of the same duration (1 min each). The tooth

whitening advert portrayed a young woman with high smile esthetics, bright pearly-white teeth without any visible anomaly. The control grouped watched a commercial advert without people or visible teeth.

2.4. Measures

The outcome measures were completed after exposure to either of the adverts and viewing three images in a questionnaire, comprising structured twelve questions to analyse four categories of personal characteristics: SC (Social Competence), IA(Intellectual Ability), PA (Psychological Adjustment) and A (Attractiveness) was adopted from previous studies [17,24,20,21]. The total score of the constructs was reported by adding the individual items' score. The scales were scored in such a way that higher scores illustrated more negative attributes. The scale was assessed for internal consistency using Cronbach's alpha. The question pertaining to age estimation was unreliable and as such was excluded from further analysis. The overall alpha (range alpha=0.714, -0.746 for the darkened, natural and whitened dental conditions) suggested that the scale's reliability was high.

2.5. Analysis

The data were analysed in three stages. First the sociodemographic characteristics of the participants were analysed. Second, the mean ratings across all the four constructs were compared between the two groups. Finally, general linear models were calculated for each of the outcome variables to explore any interaction between the respondents' gender, tooth shade and groups. Analysis was conducted using SPSS v.27 for Mac. Both descriptive and inferential statistical methods were used.

3. Results

3.1. Participants' characteristics

A total of 140 Caucasian participants were enroled. Of these, 129 agreed to participate and 11 were excluded, as depicted in Fig. 1. The process of randomisation did not result in equal numbers of participants

Table 1
Frequencies for participants' gender, age, self- oral health ratings, perceived tooth shade and education.

Participants' characteristics	Control ($N = 62$)	Experimental ($N = 67$)	Total ($N = 129$)	X^2	p value
Gender					
Male	18	23	41	0.42	0.57
Female	44	44	88		
Age					
<20	1	5	6		
20–29	36	39	75		
30–39	11	10	21	4.48	0.35
40–49	8	4	12		
50–59	6	7	13		
60+	–	2	2		
Education					
Up to GCSE, A level	5	13	18		
Under graduation	39	42	81	5.64	0.13
Post-graduation	16	9	25		
PhD	2	3	5		
Oral health					
Excellent	4	6	10		
Very good	20	19	39	1.38	0.85
Good	26	24	50		
Fair	10	15	25		
Poor	2	2	4		
Tooth shade					
Natural	41	46	87		
Whitened	13	13	26	0.23	0.89
Darkened	8	7	15		

in the two groups. The demographic profile is summarised in Table 1. Group 1 (control group) consisted 44 women and 18 men aged 17–59 years. Group 2 (experimental) contained 44 women and 23 men aged 17–65 years. The majority (70%) of the participants rated their oral health as 'good' or 'very good' and had been educated to undergraduate level or higher (70%). The respondents predominantly (67%) identified their tooth shade as 'natural'. Comparisons of the socio-demographic characteristics using Chi-square tests (age distribution, gender, education level, self-rated oral health, perceived tooth shade) between the two groups revealed no significant effect (all $p>0.05$).

3.2. Ratings of the photographs

Table 2 summarises the mean ratings of social judgement measures across the three conditions between the two groups. As can be seen from Table 2, irrespective of the tooth shade, the mean scores of most of the questions were higher in the experimental group than the control group. The exceptions were the questions that inquired about graduation and introversion/extraversion, where the participants in the control group gave higher ratings than the experimental group in all the conditions. With the satisfaction measure, images with natural teeth were rated higher in the control (3.08) than the experimental group (3.00). Further, within the experimental and control groups, higher ratings were given to the faces with whitened teeth than the natural and darkened teeth. These differences were explored further through inferential testing. The Independent sample t-tests revealed no significant differences in the means of all the responses between the control and experimental groups (all $p>0.05$ for the independent samples t-tests). Hence, we accept the null hypothesis and hence our hypothesis that cueing participants to a tooth whitening advert would result in lower, equal and higher subjective ratings on all measures of social perceptions for darkened, natural and whitened teeth respectively than those exposed to non-dental adverts is therefore not supported. The relationship between the predictors and the responses, was tested by calculating twelve general linear models with the following dependant variables: tooth shade (darkened, natural, and whitened), participants' gender (as a covariate) and groups (control and experimental), as shown in Table 3. Two interaction terms (shade* gender and shade*group) were explored. Group was found to be associated with questions that inquired about friendliness, success, introversion/extroversion and attractiveness (all $p<0.05$). Participants' gender was significant with questions that pertained to self-confidence, social life and friendliness. The estimated age was neither related to gender and group as main effects, nor any interaction term. Whilst the satisfaction scores were the highest for the images with whitened teeth in the experimental group, there was less satisfaction for images with whitened teeth than the natural teeth in the control group (Fig. 2).

Post hoc tests (Tukey B tests with significance level set at $p<0.05$) were conducted to determine the source of any significant differences. The responses were not different across the shades (darkened/natural/ whitened) and between the groups for many of the questions. Interestingly, the *post hoc* analysis of the satisfaction measure revealed the difference to lie across all the three shades in the experimental group. Whilst there was a difference between the darkened and natural tooth condition in the control group, the whitened tooth condition did not differ from the natural tooth condition,

4. Discussion

The results of this study indicated that people's subjective ratings of social judgements were consistently higher in the experimental group across the entire three conditions (darkened/natural/whitened) suggesting that tooth colour was not in itself a reliable predictor of these ratings. However, the statistical significance of these differences was only evident for the self-satisfaction measure between the control and the experimental groups and the effect sizes were small in the range of 0.009 to 0.055. The hypothesis that cueing participants to a tooth whitening advert would result in lower, equal and higher subjective ratings on all measures of social perceptions for darkened, natural and whitened teeth respectively than those exposed to non-dental adverts is therefore not supported.

The significant differences explained by the tooth shade was, however, for only the popularity and satisfaction measures and group was associated with questions that inquired about friendliness, success, introversion/extroversion and attractiveness (all $p<0.05$). Though not all measures statistically significant, these findings reveal that participants were self-satisfied with a whitened dental appearance. The findings are in agreement with previous work that examined the impacts of whiteness of teeth [21,25], tooth colour [21,23] on social judgements and similar research on faces with dental caries [26] and dental malalignment [27,28]. It further extends previous work by illustrating that exposure to 'tooth-whitening adverts' (priming) results in greater perceived social competence, intellectual ability, satisfaction and attractiveness, irrespective of the tooth shade compared to those exposed to a 'non-dental advert'.

Failure to detect a marked difference in the subjective ratings across the tooth shades may be due to several reasons. There is research to suggest that the individuals' overall facial attractiveness impacts more than their dental condition on social perceptions [20]. It is a possibility that the participants in this study focused more on the overall attractiveness of the faces and the dental condition only moderated the responses. Further, there has been some evidence that a more appearance-sensitive person could be negatively influenced by media upon their own orofacial aesthetics (Laus, 2020). Perhaps the sample involved fewer sensitive individuals that a marked difference in the subjective ratings could not be established. Moreover, the baseline attractiveness of the faces in the images was not considered. Future research might be designed on two different timelines (before and after being cued to tooth-whitening advert) to assess and compare the impact on dentally induced social judgements. Alternatively, some participants

Table 2

Mean scores (SD) for social judgement measures by image type (Darkened/Natural/Whitened) and group (Control/Experimental).

Measures	Darkened		Natural		Whitened	
	Control Mean (SD)	Experimental Mean (SD)	Control Mean (SD)	Experimental Mean(SD)	Control Mean(SD)	Experimental Mean(SD)
Popularity	3.27(0.79) a	3.34(0.84) **a b**	3.45(0.74) a b	3.52(0.75) **a b**	3.52(0.80) a b	3.73(0.69) **b**
Friendliness	3.83(0.87) a b	4.05(0.64) **a b**	3.81(0.85) a b	4.00(0.78) **a b**	3.95(0.80) a b	4.18(0.72)a **b**
Social life	1.18(0.67) a b	1.27(0.69) **a b**	1.13(0.64) a b	1.21(0.69) **a b**	1.19(0.67) a b	1.42(0.63) **a b**
Success	3.29(0.76) a	3.48(0.84) **a**	3.45(0.76) a b	3.70(0.76) **a b**	3.48(0.74) a b	3.78(0.60) **a b**
Intelligence	3.34(0.68) a	3.45(0.68) **a**	3.55(0.80) b	3.73(0.79) **b**	3.60(0.71) a b	3.73(0.69) **b**
Graduation	1.18(0.69) a	1.10(0.87) **a**	1.16(0.75) a b	1.28(0.71) **a b**	1.29(0.69) a b	1.40(0.68) **b**
Introversion/Extroversion	3.48(0.86) a b	3.43(0.89) **a**	3.40(0.76) a b	3.12(0.95) **a b**	3.55(0.78) a b	3.24(0.80) **a b**
Happiness	3.90(0.80) a b	4.01(0.66) **a b**	3.86(0.79) a b	3.91(0.73) **a b**	3.92(0.75) a b	3.97(0.60) **a b**
Self-confidence	3.31(0.92) a	3.48(0.80) **a b**	3.60(0.83) a b	3.51(0.89) **a b**	3.57(0.92)a b	3.64(0.67) **a b**
Attractiveness	2.68(0.74) a	2.75(0.94) **a**	2.84(0.85) a	3.03(0.80) **a b**	2.87(0.84) a	3.3(0.82) **b**
Satisfaction	1.79(0.87) a	1.81(0.89) **a**	3.08(1.11) b	3.00(1.11) **b**	3.52(1.13) b c	3.99(1.05) **c**

Table 3
General Linear models.

Main effects, covariates and interaction	F value	Degrees of freedom	Sig.	Effect size
Popularity				
Shade(D,N,W)	8.53	1	**0.004**	0.063
Shade*Gender	3.89	1	0.051	0.030
Shade* Group	0.60	1	0.440	0.005
Gender	1.21	1	0.274	0.010
Group	1.82	1	0.180	0.014
Friendliness				
Shade(D,N,W)	1.99	1	0.161	0.016
Shade*Gender	1.18	1	0.280	0.009
Shade* Group	0.003	1	0.955	0.001
Gender	4.57	1	0.035	0.035
Group	6.23	1	**0.014**	0.047
Social life				
Shade(D,N,W)	0.01	1	0.945	0.000
Shade*Gender	0.12	1	0.727	0.001
Shade* Group	0.69	1	0.408	0.005
Gender	4.61	1	**0.034**	0.035
Group	3.96	1	**0.049**	0.031
Success				
Shade(D,N,W)	0.90	1	0.343	0.007
Shade*Gender	0.02	1	0.892	0.000
Shade* Group	0.42	1	0.518	0.003
Gender	0.06	1	0.804	0.000
Group	7.21	1	**0.008**	0.054
Intelligence				
Shade(D,N,W)	0.01	1	0.945	0.000
Shade*Gender	0.88	1	0.349	0.007
Shade* Group	0.05	1	0.822	0.000
Gender	0.09	1	0.759	0.001
Group	2.72	1	0.101	0.021
Graduation				
Shade(D,N,W)	0.01	1	0.926	0.000
Shade*Gender	0.59	1	0.442	0.005
Shade* Group	1.30	1	0.256	0.010
Gender	0.54	1	0.462	0.004
Group	0.48	1	0.491	0.004
Introversion/ Extroversion				
Shade(D,N,W)	0.44	1	0.507	0.004
Shade*Gender	0.75	1	0.388	0.006
Shade* Group	1.73	1	0.191	0.014
Gender	2.59	1	0.110	0.020
Group	6.17	1	**0.014**	0.047
Happiness				
Shade(D,N,W)	0.08	1	0.783	0.001
Shade*Gender	0.06	1	0.810	0.000
Shade* Group	0.11	1	0.739	0.001
Gender	0.68	1	0.411	0.005
Group	0.95	1	0.331	0.008
Self-confidence				
Shade(D,N,W)	0.24	1	0.627	0.002
Shade*Gender	0.01	1	0.945	0.000
Shade* Group	0.21	1	0.648	0.002
Gender	6.22	1	0.014	0.047
Group	0.51	1	0.478	0.004
Attractiveness				
Shade(D,N,W)	0.01	1	0.910	0.000
Shade*Gender	0.86	1	0.355	0.007
Shade* Group	3.04	1	0.084	0.024
Gender	0.88	1	0.351	0.007
Group	4.55	1	**0.035**	0.035
Satisfaction				
Shade(D,N,W)	18.35	1	**0.001**	0.127
Shade*Gender	0.03	1	0.866	0.000
Shade* Group	3.78	1	0.054	0.029
Gender	1.93	1	0.167	0.015
Group	1.11	1	0.295	0.009

might have been reluctant to make harsh judgements because they felt they ought not to judge someone based on appearance.

Interestingly, all participants associated natural dental appearance with greater satisfaction in the control than the experimental group. However, the satisfaction with whitened dental appearance was higher in the experimental than the control group and this difference was statistically significant. There is a possibility that the 'tooth-whitening' advert influenced the ideals pertaining to whitened teeth. It is proposed that some young women get an insight of the way they should look by carefully studying advertisements with attractive models and by comparing themselves with those idealised images(Pedalino and Camerini 2022). In contrast to this, a recent study involving female orthodontic patients found less impact of social comparison on the judgements of dental malalignment. Nevertheless, non-patients associated dental malalignment with greater subjective ratings than orthodontic patients [29]. It is likely that the individuals in this study unintentionally related whiteness of teeth with attractiveness, good oral hygiene, self-esteem and ultimately drew out stereotypic behaviours. These reported findings were after an acute exposure to a short advert (1 min duration). Considering that similar adverts are extensive and profound in a variety of media every day, it is plausible that chronic exposure creates unconscious desire amongst the individuals to resemble the models portrayed in the media and is fairly a reason for the increasing demand for aesthetic dental procedures.

There are strengths and weaknesses within the methodology adopted in this study. It involved an analogue experimental design; participants were randomly allocated to either of the groups and the order of image display was also randomised. The possibility that the differences observed may be related to differences between the observers and the image display is therefore unlikely. The photographs were standardised and we found that the faces can be reliably differentiated as 'darkened', 'natural' and 'whitened'. Unlike the previous studies which used only 2–3 photographs, the participants in this study rated a range of photographs. A total of 54 photographs were randomised and each individual viewed three different faces of darkened, natural and whitened teeth.

The participants and the faces in the images shown were of a similar ethnic background (Caucasians). It has been postulated that the judgements made of other people vary across cultural and ethnic backgrounds [30]. The two groups were comparable with none of the demographic factors being significant. Further to this, the sample involved a wide age group. It was felt that this particular age group fell into the peer group of chosen images and their opinions were considered valid. This may be considered as a fair representation of the general population. However, recreating the study with younger participants and from diverse ethnic backgrounds, may give different results.

The findings of our study should be interpreted by a consideration of some of its limitations. The digitally modified faces permitted an increased standardisation by limiting the confounding-factors and enabling to focus on dental appearance. However, in real-life it is very unlikely that people judge each other based on dental condition and pearly white smile alone. Nevertheless, a previous study using the display of photographs demonstrated such responses are not random and obvious dental anomalies do influence subjective ratings [14]. It could be interesting to examine such judgements on natural settings in the future. Whilst there was sufficient power to test the primary hypothesis, any interaction between the shades, gender and the responses may have been detected with more power.

5. Conclusions

Priming has little impact on dentally induced social judgements as this study failed to demonstrate statistically significant differences between the non-dental advert and the tooth whitening advert groups. Nevertheless, both groups gave the highest subjective ratings for the faces with whitened teeth and the tooth-whitening advert group associated the faces in the photographs with non-significant higher subjective ratings than the non-dental advert group irrespective of the tooth shade. One reason for this could be the way the media affects the psychological well-being.

Means with different subscripts (a b c) are statistically different at the 95% CI as revealed by the Post-Hoc Tukey B test.
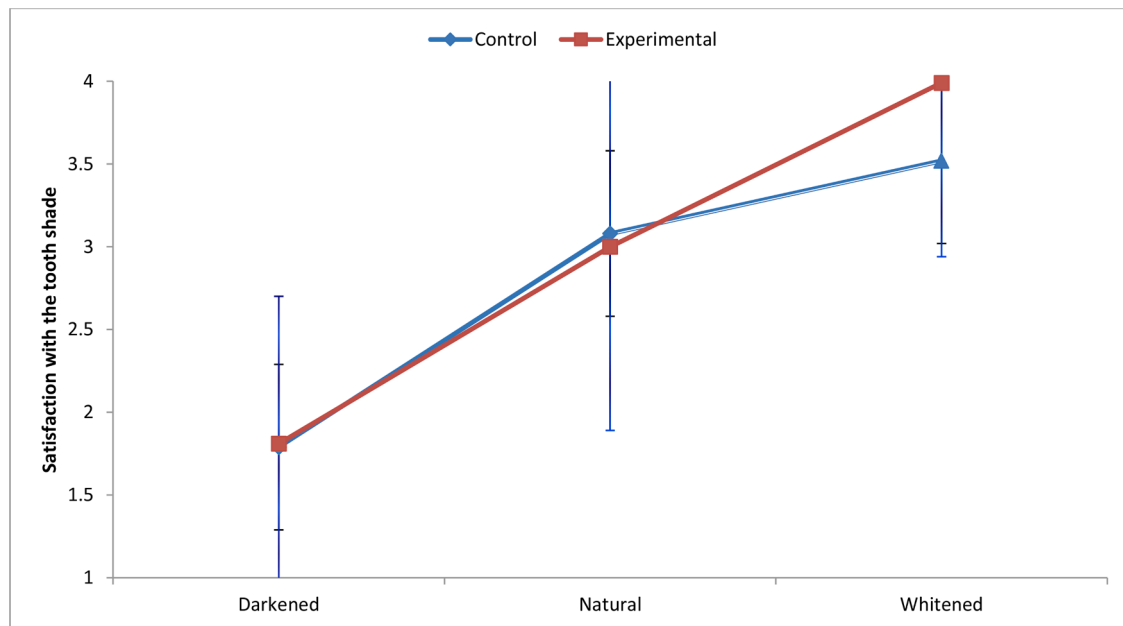
Fig. 2. : Interaction of image type (Darkened/Natural/Whitened) and group (Control/experimental) on judgements of satisfaction. Higher scores indicate greater satisfaction. Blue- control group, diamond- means of the ratings in the control group for satisfaction measure. Red- Experimental group, square- means of the ratings in the experimental group for satisfaction measure.

CRediT authorship contribution statement

Sadhvi Shankar Subramanian: Writing – review & editing, Conceptualization, Formal analysis, Data curation. **Koula Asimakopoulou:** Conceptualization, Methodology, Writing – review & editing, Formal analysis. **Tim Newton:** Conceptualization, Methodology, Project administration. **Anita Chopra:** Formal analysis, Conceptualization, Data curation. **Wen Luo:** Writing – review & editing, Software, Conceptualization, Methodology. **Andrew Joiner:** Investigation, Writing – review & editing, Conceptualization, Methodology, Project administration.

Declaration of Competing Interest

As the corresponding author, I declare as conflict of interest that Andrew Joiner, Wen Luo and Anita Chopra are all employees of Unilever Oral Care.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jdent.2022.104347.

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