CHAPTER 1: INTRODUCTION

"Now it appears that facial esthetics is again in the forefront as we realize why patients come to us in the first place."

Wahl, 2005

Contemporary society places significant emphasis on physical appearance in general and on facial attractiveness in particular (Giddon, 1995). It is clear that appearance is an important influence in one's social interaction with others and has a bearing on one's own self-esteem (Thornhill and Gangestad, 1999). Although there is universal or cross-cultural agreement on the perception of attractiveness (Maret, 1983; Maret and Harling, 1985), there is a body of evidence which indicates that these perceptions are either environmentally induced (Dion and Bersheid, 1974), genetic in origin (Samuels and Ewy, 1985; Langlois, Roggman, Casey *et al*., 1987) or share an evolutionary basis (Thornhill and Gangestad, 1993).

In recent years, a significant body of research has been devoted to various aspects of perception including the influence of culture, age and the biological basis of face recognition and feature discrimination (Kissler and Bauml, 2000). Although some investigations have speculated on the differences in face-processing between children and older adults (Ellis and Flin, 1990; Carey, 1992), there is a lack of information in the literature regarding how or whether these perceptions change with age and over time.

CHAPTER 2: LITERATURE REVIEW

2.1 Aesthetics and perception

The term *aesthetics* is derived from the Greek word for sensory perception or *aesthesis* and was coined by the 18th century philosopher Alexander Baumgarten who established aesthetics as a separate field of philosophy. A definition of aesthetics is 'the science of beauty in nature and arts' or the appreciation or the enjoyment of beauty' (Webster's Dictionary, 1988).

Studies of facial perception and recognition suggest that faces differ markedly from other physical objects of equal complexity; thus faces convey information over and above what is physically apparent at a visual level (Hirschberg, Jones and Haggerty, 1978). The perception of facial attractiveness is multifactorial and is founded primarily on genetics, culture and environmental factors (Naini and Moss, 2004). There is a dichotomy with respect to the origin of the perception of facial beauty- viz. is perception dependant on each individual's personal senses or is it common to all people? The subjective nature of facial beauty is best illustrated by the writer Margaret Hungerford's classic statement 'Beauty is in the eye of the beholder' (1878). The perceptual judgement of facial aesthetics is based on a 'sense' which is largely independent of intellectual input yet takes into consideration the influence of specific facial features. However, beauty also has a universal appeal often related to some observed physical quality or perceived emotional attribute in a face. Philosophical debate therefore varies between those embracing the universal nature of beauty and those who believe that the perception of beauty is very much an individual assessment strongly influenced by one's own ideas and feelings.

There is also conflicting opinion regarding the aesthetic appeal of average versus highly attractive faces. In the late 19th century Francis Galton (1879) overlaid photographs (one in front of the other) of convicted prisoners, producing composite portraits. These he felt were *'better looking than their components, because the average portrait of many persons is free from the irregularities that previously blemish the looks of each of them'*. Similar findings have been demonstrated by others including Symons (1979), Langlois and Roggman (1990) and Edler (2001). 'Averageness' as well as symmetry therefore, is an important component of attractiveness. These findings, however, are not in agreement with those of Perrett, May and Yoshikawa (1994) who showed that the mean shape of a group of attractive faces was preferred to the mean facial shape of the sample from which the faces were selected. This supports the view that an average face is attractive but not optimally so and that highly attractive faces are neither average (Alley and Cunningham, 1991) nor symmetrical (Zaidel, Aarde and Baig, 2005).

Arguments have also been made for an evolutionary basis to man's perception of facial attractiveness (Thornhill and Gangestad, 1993). Facial attractiveness, symmetry and secondary sexual characteristics (prominent chins and large jaws in males and malar eminences in females) with dimensions very close to the mean of the population are necessary for sexual selection and reproduction. This is true for animals as well as humans. Thornhill and Gangestad (1999) examined the three major lines of research that have been explored as indicators of phenotypic condition and found that facial symmetry, averageness and secondary sexual characteristics all played a meaningful role in the perception of facial attractiveness. Cardenas and Harris (2006) showed that man's evolutionary bias towards symmetry has had

an effect on cultural practices such as face painting and the decorative arts; these were considered to be more attractive the more symmetrical they were.

The observations of Martin (1964) support the environmental and cultural basis for facial attractiveness. He found that both White and Black American men preferred Black female faces with Caucasoid features compared with Black African men who preferred Black female faces with Negroid features. More recent studies by Cunningham (1995) and Langlois, Kalanakis, Rubenstein *et al.* (2000) confirmed this cross-cultural agreement with respect to facial attractiveness.

2.2 Facial aesthetics, art and history

Art through the ages and the portrayal of the human face are intricately linked. Documented art of the early civilizations served as the medium through which depictions of the ideal facial form and proportion of that time were recorded. These early representations of the human form date back to pre-historic man's rock paintings and stone carvings. Art of the Paleolithic era some 35000 years ago showed poor and infrequent representation of the human form compared with the more numerous and detailed depictions of hunting themes (Peck and Peck, 1970). Greater attention to detail, especially of the human face, was recorded by the ancient Egyptian, Greek and Roman civilizations (Vegter and Hage, 2001).

The ancient Egyptians were amongst the first to attempt description of facial and bodily proportions in mathematical or grid form. The early Egyptian artists (circa 2600 BC) were prolific in their renditions of the Egyptian ideal of beauty, harmony and proportion, as evidenced in the art and statues uncovered in the tombs of Egyptian royalty of the Old

Kingdom. The grid system employed by them resulted in round faces, sloped foreheads, straight noses, strong chins as well as bimaxillary dento-alveolar protrusion.

The main contribution to aesthetic ideals, however, was made by the ancient Greek civilization. Greek philosophers, sculptors and artists of the fourth and fifth century BC also developed intricate formulae to depict their ideal human form. Guidelines were laid down by a number of artists including Polykleitos whose famous sculpture 'The Lance Bearer' conformed to established proportions of the time. Classical Greece sought to express its concept of beauty through the art, sculpture and philosophy during a time often referred to as the Golden Age of Greece. Facial features of both males and females were represented with an anteriorly prominent forehead and a straight nasal profile from forehead to nasal tip. In profile view, the mouth was orthognathic with an undulating upper lip, slightly rolled lower lip and a well-defined labiomental sulcus while when viewed from the front, the Greek face typically assumed an oval appearance with a slight taper towards the chin. However, this changed during the ensuing Greek Hellenistic period towards a more realistic, less romanticized depiction of facial form.

Although the conquering Romans perpetuated this realistic view of facial form, they did so largely by copying Greek sculptures and art. Although the Romans relied on the work of the Greeks, there were some significant original contributors such as the architect Vitruvius, whose famous facial trisection is still used in contemporary orthodontic and surgical practice. This period saw artists moving away from depictions of ideal facial form to a more spiritual and moral interpretation of beauty. But during the Dark and Middle Ages realistic depictions

of facial and bodily form were all but suppressed. It was only during the 15th century that realistic aesthetic values came to be expressed again.

The 15th century Italian Renaissance was a period of cultural, artistic and scientific awakening. This era boasted the art of Michelangelo and the art and science of Leonardo da Vinci. Michelangelo's sculpture of David displayed an extension of the Greek and Roman classical face and it represented the aesthetic ideals of the prevailing period. The importance of proportion also influenced luminaries like Leonardo. His depiction of the Vitruvian man was based on guidelines of proportion as described by Vitruvius. For example, the distance from the hairline to the inferior aspect of the chin was described as being one-tenth of a man's height and the distance from the top of the head to the inferior aspect of the chin being one-eighth of a man's height.

Albrecht Durer, the 16th century artist felt that although facial attractiveness was largely a subjective assessment, the appraisal of facial proportions could be performed objectively. Disproportionate faces were considered unaesthetic whereas those exhibiting proportionality were deemed acceptable or beautiful. Thus facial proportions became a key tool in the representation of the human form by the early artists, painters and sculptors. These were done in the form of 'canons' or guidelines based mainly on the subjective opinion of the individual artist.

A well-documented concept is that of the 'golden proportion' which was labeled the 'divine proportion' by the mathematician Luca Pacioli (1509). It was defined as the place where a line is sectioned so that the ratio of the small to the large section is the same as that of the large

section to the whole line. In essence the larger section is 1,618 times that of the smaller one. Pacioli's treatise *De Divina Proportione (On Divine Proportion)* contained drawings of proportionate faces and symmetrical figures by Leonardo Da Vinci based on the divine proportion.

Many researchers have attempted to correlate ideal facial proportions with the golden proportion (Levin, 1978; Ricketts, 1982a; 1982b). Contemporary opinion, however, doubts the value of the divine proportion in its application to facial form (Peck and Peck, 1995; Moss, Linney and Lowey, 1995; Baker and Woods, 2001).

More recently, Marquardt (2002) has expanded on this concept and introduced the Golden Decagon Mask, a configuration that describes the golden proportion in two dimensions. In his search for a quantifiable measure of attractiveness, Marquardt studied the faces of movie stars and models and found that the golden ratio occurred more frequently in more attractive faces than in less attractive individuals. The configuration that described the golden ratio in two dimensions was an acute golden triangle with sides of 1,618 and a base of one or an obtuse triangle with a base of 1,618 and sides of one. These together formed a golden pentagon which if duplicated, inverted and superimposed on itself produced the golden decagon. This resulted initially in a Golden Decagon Mask for a post-pubescent female and the subsequent development of a different mask for the young child and post-pubescent male. However, the facial masks of Marquardt have been criticized as they describe the facial proportions of masculinised White women as seen in fashion models, and further, do not take into consideration ethnicity, especially of sub-Saharan Africans and East Asians (Holland, 2008).

Ferring and Pancherz (2008) evaluated the extent to which facial proportions changed in comparison with the divine values during growth. Their investigation showed that the facial proportions changed only minimally between the ages of six and a half years and thirty years, indicating that these proportions seemed to be predetermined already in childhood, with only slight variations during growth with no discernible gender differences. In addition, it appeared that people with attractive faces demonstrated greater concordance with the golden proportions than did those with average faces.

The 17th and 18th centuries saw the reaffirmation of classical Greek aesthetic ideals largely due to the German art historian Johann Winckelmann who influenced opinion both in Europe and in the United States. His admiration of the sculpture of the Apollo Belvedere and the Aphrodite of Melos as representations of universal beauty significantly influenced 19th century orthodontists in the United States including Norman Kingsley, Calvin Case and Edward Angle. Angle (1907) regarded the bust of Apollo Belvedere as “a study of symmetry and beauty of proportion”. However, it was Calvin Case (1921) who first suggested a range of aesthetic outcomes that might be considered acceptable based on the variation of faces that were likely to present for treatment.

It was only in 1957 that Wilson dismissed the belief in the Greek aesthetic ideal, calling it erroneous and exhibiting ‘retrusion of the lower third of the face’. In the 1970’s a study by Peck & Peck revealed the public’s preference of a fuller face over the flat Apollo-like profile. It was their contention that ‘the ultimate source of our aesthetic values should be the people, not just ourselves (orthodontists).’ They cited Wylie’s (1959) contention that the layperson’s

opinion of the facial profile is as good as, if not better than, that of the orthodontist as it is not conditioned by ‘orthodontic propaganda’ (Peck and Peck, 1970).

In order to determine which faces Britons found most appealing, Iliffe (1960) published standardised photographs of 12 English girls between the ages of 20 -25 years in a British daily newspaper. The general public was invited to rank these photographs in order of attractiveness. Udry (1965) performed a similar study in the U.S.A. some five years later, publishing the same photographs in an American Sunday newspaper. Both studies were remarkably consistent in their findings and showed that adult British and American Caucasians, irrespective of their age, sex, nationality or occupation, shared a preference for a fuller female facial profile. Similar cross-cultural agreement has been demonstrated in more recent studies (Jones and Hill, 1993; Perrett, May and Yoshikawa, 1994) which appear to support the claim that people share a common aesthetic standard. However, other investigators have produced conflicting findings (Lines, Lines and Lines, 1978; Prahl-Andersen, Boersma, van der Linden *et al.*, 1979; Kerr and O’ Donnell, 1990). Lines, Lines and Lines (1978) found statistically significant differences in facial profile preferences according to gender and occupation (dental professionals versus laypersons). Prahl-Andersen *et al.* (1979) also found significant differences between parents’ and professionals’ evaluations of children’s facial profiles and dental features. Parents considered more examples to be ‘acceptable’ and not in need of treatment compared with the opinions of dental professionals. Similar differences were found by Kerr and O’ Donnell (1990) in their study of the preferences of dental students, orthodontists and the parents of patients undergoing orthodontic treatment.

Nguyen and Turley (1998), Auger and Turley (1999) and Yehezkel and Turley (2004) reviewed time-related changes in aesthetic facial ideals and showed that over the course of the first 90 years of the twentieth century Americans have come to demonstrate a preference for male and female Caucasian and African American models with progressively fuller and more prominent lips. In the last few decades, faces perceived to be attractive appear to have maintained these lip characteristics (Bisson and Grobbelaar, 2004).

Like art, a common goal of anthropometry over the ages has been the expression of physical proportions in value form. Some judgements of facial appeal involve the comparison of faces with well-defined anthropometric norms and proportions as described by Koury and Epker (1992). However, until a few centuries ago these features and proportions were not realistically represented. Instead they were depicted by artists and scientists according to their personal preferences. Contemporary anthropometric investigations undertaken by Farkas *et al.* (1985a; 1985b; 1987) have been influential in allowing comparison of historical ideals and current preferences. Although their studies showed that the classical ideals may fit a few cases, they do not represent contemporary facial proportions and therefore should not be an automatic prescription in diagnosis and treatment planning. Nevertheless, the influences of art, science, anthropometry and cephalometry have all contributed to the contemporary vision of the ideal facial form.

Early orthodontic practice in the USA generally followed the Angle philosophy, the goal of which was to produce ideal occlusion with a full complement of teeth, and this would, it was believed, produce optimal facial attractiveness. This approach was later challenged by Calvin Case in the 1920s and Charles Tweed in the 1950s. In more recent times, greater attention has

been focused on the centrality of the soft tissue drape in orthodontic and orthognathic diagnosis and treatment-planning (Proffit, White and Sarver, 2003). The creation of a well-balanced soft-tissue profile is now accepted as an important goal of orthodontic treatment as well as forming a common objective among the various dental disciplines.

2.3 Factors influencing the perception of facial aesthetics

According to Edler (2001) it would seem that our perceptions of facial attractiveness are inherited (or inherent), universal (or cross-cultural) and instinctive. The instinctive nature of the perception of attractiveness led to the view that beauty was a representation of the average values for features of facial form in a human population (Symons, 1979). In addition Cunningham (1986) and Cunningham, Barbee and Pike (1990) showed that men were especially attracted to 'neonatal-type' features in women (large foreheads, large, wide set eyes, small nose and chin and full lips) while females were attracted to males who had 'mature' characteristics such as wide jaws, strong chins and relatively thin lips. 'Expressiveness' was also a feature of the most attractive male and female faces (Edler, 2001). This included attributes such as a broad smile and high-arched eyebrows.

There is also a biological and evolutionary element to facial attractiveness which is closely associated with the processes of sexual selection. At a basic level, only healthy, pathogen-resistant animals can develop and maintain their secondary sexual characteristics and provide genetic parasite resistance to their offspring (Sarwer, Grossbart and Didie, 2003). Attractiveness may therefore be a sign that a prospective partner is pathogen-free. This theory may also influence humans in their assessments of suitable mates. Gangestad and Buss (1993) showed that men and women from countries with high disease and pathogen prevalence (such

as Zambia, Nigeria and India) attached greater significance to physical attractiveness when choosing suitable partners than males and females from countries in which values for these variables were low (for example Scandinavia, Norway and West Germany).

Animal studies have also revealed that bilateral symmetry is an indicator of a pathogen-free organism which may offer a greater probability for reproductive success (Thornhill and Gangestad, 1993). A similar trend was observed in humans where males and females with bilaterally symmetrical facial features were considered more attractive by both male and female judges (Grammar and Thornhill, 1994; Perrett, Burt, Penton-Voak *et al.*, 1999). This preference for symmetry was found in both sexes but was stronger in men than in women. Evolutionary theorists, citing current theoretical and empirical opinion have suggested that facial symmetry signals health and fitness and that under ideal developmental conditions, paired anatomical structures such as the eyes and ears develop synchronously resulting in more symmetrical and hence more attractive individuals (Grammer, Fink, Moller *et al.*, 2003). Extrinsic factors such as pathogens, trauma and environmental pollutants might adversely affect this symmetrical development. Therefore it is believed that only the strongest and healthiest develop facial and physical symmetry in spite of these potential insults (Thornhill and Gangestad, 1993).

Many guidelines, norms and ideal ratios and angles dealing with facial attractiveness have been proposed. These have for the large part, been based on adult faces, beautiful or idealized faces or the author's preferences. Others have been based on 'average' faces (Koury and Epker, 1992). Faces depicting average values have been considered 'ideal' (Symons, 1979) and these average facial proportions could therefore provide a basis for the quantitative

evaluation of facial aesthetics. Halazonetis (2007) found only minor differences in the average facial shape of adolescents between the ages of seven and seventeen years, and generally, most clinicians use the 'ideal' norms for all patients irrespective of their age or gender. On the other hand, Kiekens, Kuijpers-Jagtman, van't Hof *et al.* (2008) investigated the relationship of ideal angles and ratios to facial attractiveness in adolescents and found a poor correlation, with only a few displaying a significant association.

Alley and Cunningham (1991) contended that the most attractive faces are not average; rather they are atypical in terms of specific facial features as well as overall facial structure. Generally, these faces were said to exhibit characteristics of youthfulness such as a smaller mouth, smaller vertical and transverse dimensions, fuller lips and prominent eyes and cheekbones. According to evolutionary theory, youthfulness implies an extended period of reproductive potential (Symons, 1979). Although ratings of physical attractiveness in males and females decline with age, the trend is more pronounced in females which suggests that standards for men are less connected to youth than they are for women. Nevertheless, looking young may be more important than actually being young. Cunningham (1986) demonstrated how male judges rated faces that appeared to be younger than they actually were to be more attractive than those that were age-appropriate or appearing older than they actually were.

Data from brain imaging studies support the notion that the human brain possesses regions that are responsive to attractiveness. Preferences for attractiveness begin early in life (Langlois *et al.*, 1987). Similarly, right hemisphere specialisation for facial processing starts in infants four to nine months old (de Schonen and Mathivet, 1989; 1990). Using a theoretical approach that treated the viewing of faces as akin to reward, O'Doherty, Winston, Critchley *et al.* (2003)

showed that the orbitofrontal cortex responds to attractive faces while lateral regions respond more to unattractive faces. Other regions thought to play an important role in facial attractiveness include the amygdale, the fusiform and superior temporal sulcus (Winston, O'Doherty, Kilner *et al.,* 2007). From an anatomical and physiological perspective, contemporary research indicates that facial discrimination is an interaction of current visual sensory input (face feature perception and face structure perception) and retrievable memory (Dolan, Fink, Rolls *et al.*, 1997; Barton and Cherkasova, 2003). Variable sensory processing is also present in normal subjects, examples of which include smell, taste and auditory ability, visual acuity and learning and recall ability. It is therefore likely that considerable variation may exist between the clinician and the patient, parent or layperson in the evaluation of facial appearance. This variability originates from the individual's inherent capability and his or her visual perceptual experience (Masella and Meister, 2007). Some of these 'hard-wiring' influences include visual acuity, recall ability, memory capacity and neural pathways to and from cortical processing areas (Masella and Meister, 2007).

The use of functional magnetic resonance imaging (fMRI) of the brain and cranial electrophysiology has revealed neuronal subspecialisation in specific regions of the brain for different aspects of facial perception such as facial familiarity, facial expression and spatial relationships of facial features. This organic 'hard-wiring' together with emotional, ethno-racial, cultural, gender and personal factors may have a significant influence on the perception of facial appearance. The perceptions of the orthodontic professional are important variables in the ability to objectively assess the facial appearance of and establish treatment goals for patients. Strategies to sharpen the facial discrimination ability of orthodontists have been proposed including increasing doctor-patient visual contact time before commencing active

orthodontic treatment, using three-quarter facial photographs and smiling photographs in all views, comparing photographic records of patients, parents and siblings and video recording of patient speech, smiles and facial animation in order to deepen the clinician's perceptual and memory experience (Masella and Meister, 2007). A further suggestion was the use of animated facial images as a shared communication tool between doctor and patient allowing greater patient input in planning treatment outcomes (McKoy-White, Evans, Viana *et al.*, 2006).

Subjective facial assessment is deeply rooted in these processes of visual perception. Essentially two types of information can be gleaned from the face: first-order information (based on the characteristics of internal and external features) and second-order information (based on the relationships between the features) (Karavaka, Halazonetis and Spyropoulos, 2008). Although both types of information are combined in facial recognition, they are processed differently with featural processing preceding configural processing (Itier and Taylor, 2004).

It has been suggested that people generally share a common basis for the judgement of aesthetics irrespective of their race, age, sex, occupation, nationality or dental knowledge (Iliffe, 1960; Udry, 1965; Jones and Hill, 1993; Farrow, Zarrinnia and Azizi, 1993; Perrett, May and Yoshikawa, 1994). Others however, consider the perception of facial attractiveness to be largely subjective, being influenced by a multitude of factors such as age, sex, personality, socioeconomic status, education, geographic location, culture and personal facial profile, apart from the influence of racial and ethnic differences (Polk, Farman, Yancey *et al.*, 1995; Hall, Taylor, Jacobson *et al.*, 2000; Hwang, Kim and McNamara, 2002).

Pogrel (1991) evaluated aesthetic values with respect to facial attractiveness amongst four groups, namely artists, surgeons, orthodontists and the general public and found that variation existed within each of the groups studied. While orthodontists and surgeons preferred a flatter profile, artists and the general public found a fuller profile to be more attractive. Similar findings have been reported by others (Lines, Lines and Lines, 1978; Prahl-Andersen *et al.*, 1979; Kerr and O' Donnell, 1990). Lines, Lines and Lines (1978) found significant variation in the assessment of profile silhouettes amongst orthodontists, oral surgeons, dental students and laypersons. Although orthodontists judged profiles more critically than the oral surgeons; the groups differed markedly in their evaluations when compared with those of the dental students or laypersons.

Television and the media play an important role in defining popular culture and unifying society's tastes (Peck and Peck, 1970). Many argue that the mass media is an influential promoter of beauty ideals while others contend that it merely reflects a trend of public preference (Sarwer, Grossbart and Didie, 2003). The images in print media, television and motion pictures are assimilated from early childhood and are believed to provide a daily reinforcement of certain facial stereotypes. The judgement of dentofacial aesthetics might therefore be the product of a host of cultural and social reinforcements at play in contemporary society.

It has also been suggested that evaluators of facial aesthetics should be selected on the basis of age and gender as longitudinal growth studies have demonstrated significant morphological changes in hard and soft tissues of males and females throughout life (Formby, Nanda and Currier, 1994; Nanda and Ghosh, 1995; Bishara, Jakobsen, Hession *et al.*, 1998) which may

alter one's perception of ideal facial aesthetics over time. Nevertheless, people tend to retain their relative levels of attractiveness throughout their lives (Tatarunaite, Playle, Hood *et al.*, 2005). Kissler and Bauml (2000) assessed the effects of the beholder's age on the perception of facial attractiveness by presenting pairs of women's and girl's faces to 40 nine-year-old girls and their mothers and 40 twelve-year-old girls and their mothers for assessment. They found that if the mothers demonstrated a clear preference for one of the two women's faces presented, then the children, on average, would also prefer that face. When the mothers were more or less indecisive, the children were also indifferent. Therefore, both the strength of preferences and the direction thereof varied only slightly. However, for the assessment of the girls' faces, a different pattern was noted. When adults demonstrated a strong preference for one face of a pair, the children frequently only recorded a moderate preference for the same face. This indicated that the preference for attractive faces tended to be more pronounced in adults than in children, suggesting an age-related preference for facial attractiveness. In addition, the findings support the view that children tend to rely on more isolated features when assessing facial attractiveness while adults have been shown to use both isolated and configurational aspects equally in the aesthetic judgements (Carey, 1992).

Most orthodontic studies of facial aesthetics have used facial profiles obtained from cephalometric tracings, line drawings, silhouette profiles or photographs (Barrer and Ghafari, 1985; Polk *et al.*, 1995; Hall *et al.*, 2000). However facial attractiveness is not only influenced by the soft tissue profile but also by many diverse factors such as skin texture and complexion, hairstyle and colour, eye shape and colour, makeup, facial symmetry and proportion (Spyropoulos, 1997). Many investigators consider these features to be distracting variables that could influence the rating of facial aesthetics (Barrer and Ghafari, 1985; Czarnecki, Nanda

and Currier, 1993; Phillips, Griffin and Bennett, 1995). Nanda and Ghosh (1995) believe that 'these extraneous influencing factors' should be eliminated when assessing facial attractiveness so that the process of evaluation might be more objective.

2.4 Cephalometric and aesthetic norms

Cephalometric studies have confirmed skeletal and dental differences between Negroes and Caucasians (Altemus, 1960; Altemus, 1963; Drummond, 1968; Kowalski, Nasjleti and Walker, 1974; Jacobson, 1978; Enlow, Pfister, Richardson *et al.*, 1982). Altemus (1960; 1963) compared his sample with Burstone's Caucasian standards and demonstrated protrusiveness of both hard and soft tissues in the Negroid subjects. While the upper facial profiles were similar in Blacks and Whites, Blacks exhibited more protrusive lips and teeth. Drummond (1968) found that Black Americans had a large, strong tongue and flaccid lips which allowed the teeth to be in a procumbent position. This together with the thickness of the lips made the lower face appear very full. Kowalski, Nasjleti and Walker (1974) found significant variation between Caucasians and Negroes in variables such as the proclination of the lower incisor, the degree of maxillary prognathism, the cant of the occlusal plane and interincisal angle. Jacobson (1978) demonstrated cephalometrically that South African Blacks had shorter, more anteriorly placed maxillae, shorter ramus height and severe proclination of lower incisors. Enlow *et al.* (1982) showed differences in features such as ramus width, ramus angulation and the orientation of the middle cranial fossa between Whites and Blacks.

The recognition of these morphological differences led to the development of cephalometric norms for various groups including African Americans (Cotton, Takano and Wong, 1951; Drummond, 1968; Fonseca and Klein, 1978; Thomas, 1979; Connor and Moshiri, 1985;

Flynn, Ambrogio and Ziechner, 1989), Kenyans (Kapila, 1989), Nigerians (Isiekwe and Sowemimo, 1984), Cameroonians (Bacon, Girardin and Turlot, 1983), South African Coloureds (Seedat, 1983) and South African Blacks (Jacobson and Oosthuizen, 1970; Barter, Evans, Smit *et al.*, 1995).

Cephalometric studies have also been undertaken on South African Caucasians (Sadowsky and Jacobson, 1971; 1973), South African Coloureds (Seedat, 1983) and South African and Southern African Blacks (Jacobson and Oosthuizen, 1970; Jacobson, 1978; Briedenhann and Roos, 1988; Barter *et al.*, 1995; Naidoo and Miles, 1997a; 1997b). Jacobson and Oosthuizen (1970) and Jacobson (1978) performed their studies on dry skulls and used 'excellence of occlusion' as the sole criterion for inclusion. As a result, underlying skeletal discrepancies and soft tissue profiles were overlooked. The study by Briedenhann and Roos (1988) used lateral cephalograms and intraoral and extraoral photographs to select 80 Herero-speaking Negro males with excellent Class I occlusions. The frontal and lateral photographs of these subjects as well as a random sample of 20 photographs of the others who did not have excellent occlusion were shown to 40 school teachers for their assessment of facial attractiveness. Only those chosen by all the examiners as aesthetically pleasing (41 in total) had their original cephalometric analyses compared with Caucasian norms. The findings highlighted the significant cephalometric differences between Black South Africans, African Americans and Caucasians. Barter *et al.* (1995) performed cephalometric analyses on male and female Sotho-Tswana children chosen on the basis of excellence of occlusion and an acceptable facial profile as judged by their teachers. These analyses were compared with those of Caucasians as well as other Southern African groups. The investigators found that numerous differences

existed between the groups and concluded that cephalometric norms for one group were not applicable to another.

2.5 The soft tissue profile preferences of different groups

Sushner (1977) compared the soft tissue profile preferences of Whites and Blacks in the USA using a subset of 100 profile photographs of male and female Blacks considered ‘most attractive’ out of a total sample of over 1000 African Americans previously selected by the orthodontic faculty at Howard University College of Dentistry by a group of judges of varying social status levels. These profiles were compared with the Caucasian norms of Steiner, Holdaway and Ricketts. Sushner (1977) found the African American profile to be significantly more protrusive than the White profile leading him to establish separate norms for Blacks. Foster (1973) studied the profile preferences using silhouettes of a sample consisting of a mixture of races, ages and professions. The seven individual silhouette profiles displayed a range of 12 millimetres with respect to lip protrusion. While the diverse groups polled in this study indicated that there was a common aesthetic standard for lip position, the general trend also indicated that all groups preferred fuller profiles for younger ages and straighter profiles for the adults. Therefore, whilst his study showed little difference in ideal lip position, it did emphasize the fact that younger participants preferred a fuller profile while adults preferred a straighter profile.

Martin (1964) explored the issue of race and ethnicity in his assessment of female beauty. He used 10 photographs of African Americans from Ebony and Sepia magazines which were ranked in order of aesthetic appeal by a group of 50 African American, 50 Caucasian American and 50 Nigerian students. Each group judged the beauty of the female face and the

results showed that both African and Caucasian Americans preferred the more Caucasian-appearing photographs while the Nigerian students preferred the more Negroid-appearing photographs. Thomas (1979) and De Loach (1978) both evaluated the soft tissue profile of the American Black woman. Thomas surveyed Black and White orthodontists and found that both groups preferred Black females with a mildly convex and straighter profile. De Loach used the same 10 profiles and surveyed 224 Black females instead. The females in his sample, like the orthodontists in Thomas' investigation, also preferred the straighter profile. However, when asked to match their own profiles to the 10 original profiles, many participants either chose a more ideal profile than their own or could not recognize their personal profile. Furthermore, 47% of respondents stated that they would change their profile if they had the means to do so.

Farrow, Zarrinnia and Azizi (1993) also attempted to identify what Black Americans found appealing about their profiles. Digital software manipulation of lateral facial photographs resulted in the creation of four levels of bimaxillary protrusion. These were assessed by Black and White laypersons, dentists and orthodontists. All the groups consistently chose a slightly convex profile which was more protrusive than Caucasian norms but less than what was previously thought to be the norm for Blacks.

Hall *et al.* (2000) used profile silhouettes of 30 African American and 30 Caucasian American patients and surveyed laypersons as well as Black and White orthodontists in their study. All the evaluators preferred the African American sample to exhibit greater profile convexity than the Caucasian sample. In addition, the raters preferred the African American sample to display lips that were more prominent than their Caucasian counterparts. Polk *et al.* (1995) also employed profile silhouettes in their evaluation of the soft tissue profile preferences of 150

African Americans of varying ages, social and educational backgrounds. The findings indicated that African Americans preferred flatter profiles but with fuller lips than White norms. In addition, both males and females preferred African American males to exhibit profiles which were more protrusive than females.

Investigations assessing the changes in preference of male and female facial profiles as depicted in fashion magazines during the 20th century have been rather consistent in their findings (Nguyen and Turley, 1998; Auger and Turley, 1999 and Yehezkel and Turley, 2004). Nguyen and Turley (1998) measured and described changes in the Caucasian male profile and demonstrated a trend towards increasing lip protrusion, lip curl and vermillion display over the course of the 20th century. Auger and Turley (1999) and Yehezkel and Turley (2004) similarly followed changes in the preferred soft tissue profile of White and Black females, respectively, as depicted in fashion magazines over the same period. The results of both studies showed that the aesthetic standards for both the Caucasian and African American female profile, like those for the male profile, had changed, demonstrating a trend towards fuller and more anteriorly positioned lips during the course of the 20th century.

Jackson (1985) studied the facial profiles of 27 female and 29 male Black South Africans. All of the subjects in the study had a history of being either a model or a television actor and were therefore presumed to have facial features that were desirable or ‘acceptable’ to both the media as well as their peers. The frontal photographs of these faces were ranked in order of aesthetic appeal by judges including dentists, casting agents and shop assistants. Standardised lateral facial photographs were taken on which a series of six linear and seven angular measurements were made and recorded. Facial profile measurements from the male group

were compared with the female group and with norms for a similar White group. The findings revealed significant differences between the facial profiles of the Black sample and a similar White sample as well as statistically significant differences between the profiles of favoured Black male and female groups, with a preponderance of bimaxillary protrusion in the Black sample.

Others have evaluated the soft tissue profile and the profile preferences of Black South Africans using bimaxillary protrusive facial silhouettes (Beukes, Dawjee and Hlongwa, 2007a; 2007b) and assessed the anterior dental aesthetics of Black South Africans with bimaxillary protrusion (Dawjee, Ackerman and Shaw, 2002). Their results showed that the favoured profiles demonstrated between five and six millimetres more lip protrusion than their African American counterparts. A search of the literature failed to reveal any other work assessing the facial profile preferences of South Africans.

2.6 Morphing technology and orthodontics

Early investigations utilising morphing and computer animation software in orthodontics were carried out by Giddon and co-workers. Giddon, Sconzo, Kinchen *et al.* (1994) and Giddon, Sconzo, Kinchen *et al.* (1996a) developed software to render digitally modified images of gradations of change in physical dimensions of the soft tissue profile which appeared to be continuous and to demonstrate change when viewed in slow motion. These studies compared the responses to animated feature distortions and discrete distortions of the same features and found both to be valid. A follow-up study comparing the results obtained with the original animation method to those obtained using a more advanced morphing software programme

(Giddon, Bernier, Evans *et al.*, 1996b) showed that the products of the advanced programme were almost identical to the images obtained using discrete animations.

More recent studies using these animation and morphing programmes have evaluated the influence of the magnitude of vertical and horizontal change on profile preference (Giddon, Rains, Evans *et al.*, 1997); the presurgical profile preference of patients and clinicians (Arpino, Giddon, BeGole *et al.*, 1998); the comparison of self-perception with actual profiles (Kitay, BeGole, Evans *et al.*, 1999); the comparison of perceptions of right and left-facing profiles (Anderson, Evans and Giddon, 1999) as well as ethnic differences in profile preference (Mejia-Maidl, Evans, Viana *et al.*, 2005; McKoy-White *et al.*, 2006). Miner, Anderson, Evans *et al.* (2007) used the same imaging system to compare children's self-perception of their facial profile with the perceptions of their mothers and clinicians. Their results indicated that young patients had inaccurate images of their profiles, but that the self-perception of their profiles became more accurate with age. Patients, like their mothers generally perceived themselves as having a more protrusive mandible than they actually had. In addition, mothers preferred their children (aged between 8 years and 15 years in the study sample) to have a more bimaxillary protrusive appearance. The findings of Miner *et al.* (2007) were in agreement with others in the United States, Europe and Asia who found that mothers' perceptions of dental and facial profile anomalies are the principal motivating factor for their seeking orthodontic treatment (Phillips, Trentini and Douvartzidis, 1992; Stenvik, Espeland, Linge *et al.*, 1997; Hamdan, 2004).

Morar (2007) used a series of digitally morphed greyscale androgynous lateral profile images devoid of distracting variables and which varied in terms of lip protrusion to ascertain and

compare the profile preferences of samples of rural and urban Black South African females and males. The findings of the study indicated that the perception of facial attractiveness varied only marginally between rural and urban Black South Africans. Similarly, there was little difference in the aesthetic perceptions between rural and urban Black South Africans on the basis of gender. Both the rural and urban groups and the female and male samples demonstrated consensus regarding the extremes of the range which were considered less appealing.

There are thus numerous factors that are influential in the perception of facial aesthetics. These include but are not limited to, influences such as:

- ethnic and racial factors
- cultural factors
- socio-economic factors
- extrinsic factors such as media exposure and acculturation
- genetic or 'organic' factors
- confounding factors
- age and maturity

While many of these factors have been extensively reported in the literature, there is scant reference in the literature to the potential influence of age on the perception of facial aesthetics. The aims of this study therefore were:

1. To utilise the facial templates developed by Morar (2007) to determine the preferred facial profile of heterogeneous samples of South Africans in the following age groups:
   a) school children between the ages of 9 and 19 years

b) university students between the ages of 17 and 34 years

c) school teachers between the ages of 18 and 66 years.

2. To determine whether any statistically significant differences existed in the choice of the preferred facial profile at varying ages.
3. To determine whether differences in profile preference existed on the basis of ethnicity.

CHAPTER 3: MATERIALS AND METHODS

3.1 SAMPLE

Three sample groups were utilised in this study. These comprised learners randomly selected from a number of private and public schools, a group of students, randomly selected from one university, and teachers randomly selected from the same schools as the sample of learners.

3.1.1 School learners

This sample was obtained from female and male school children between the ages of 9 and 19 years attending both private and public schools in the greater Johannesburg area. Participants from the private schools were drawn from St. Andrews School for Girls, St Mary's School for Girls, Roedean School for Girls and Bishop Bavin School. Participants from the public schools included learners from Jeppe High School for Girls, Jeppe High School for Boys and King Edward VII School for Boys. Learners were randomly selected from amongst those whose parents had provided written consent for their participation.

3.1.2 University students

The sample of randomly selected university students comprised preclinical second year students from the medical, dental and allied medical disciplines of the University of the Witwatersrand's Medical School campus in Parktown, Johannesburg. The ages of the students ranged from 17 to 34 years.

3.1.3 School teachers

The sample of randomly selected school teachers was obtained from the same private and public schools as the samples of learners. They ranged in age from 18 to 66 years.

3.2 METHOD

This investigation utilized a series of digitally morphed, androgynous, grayscale lateral facial profile images. The development and use of these facial templates has been described previously (Morar, 2007).

The series of facial templates demonstrate a range of profile protrusiveness of the lower third of the face whilst maintaining constancy between other morphological facial features. The initial anchor images representing the extremes of profile appearance, were digitally morphed using the software programme Alias Maya® (Toronto, Canada), resulting in a subset of intermediate facial profile images. These were sequentially arranged in grades from the extremely retrusive profile through to the straight profile to the extremely protrusive profile. A4-size replicas of the series of facial profile templates appear in Appendix F.

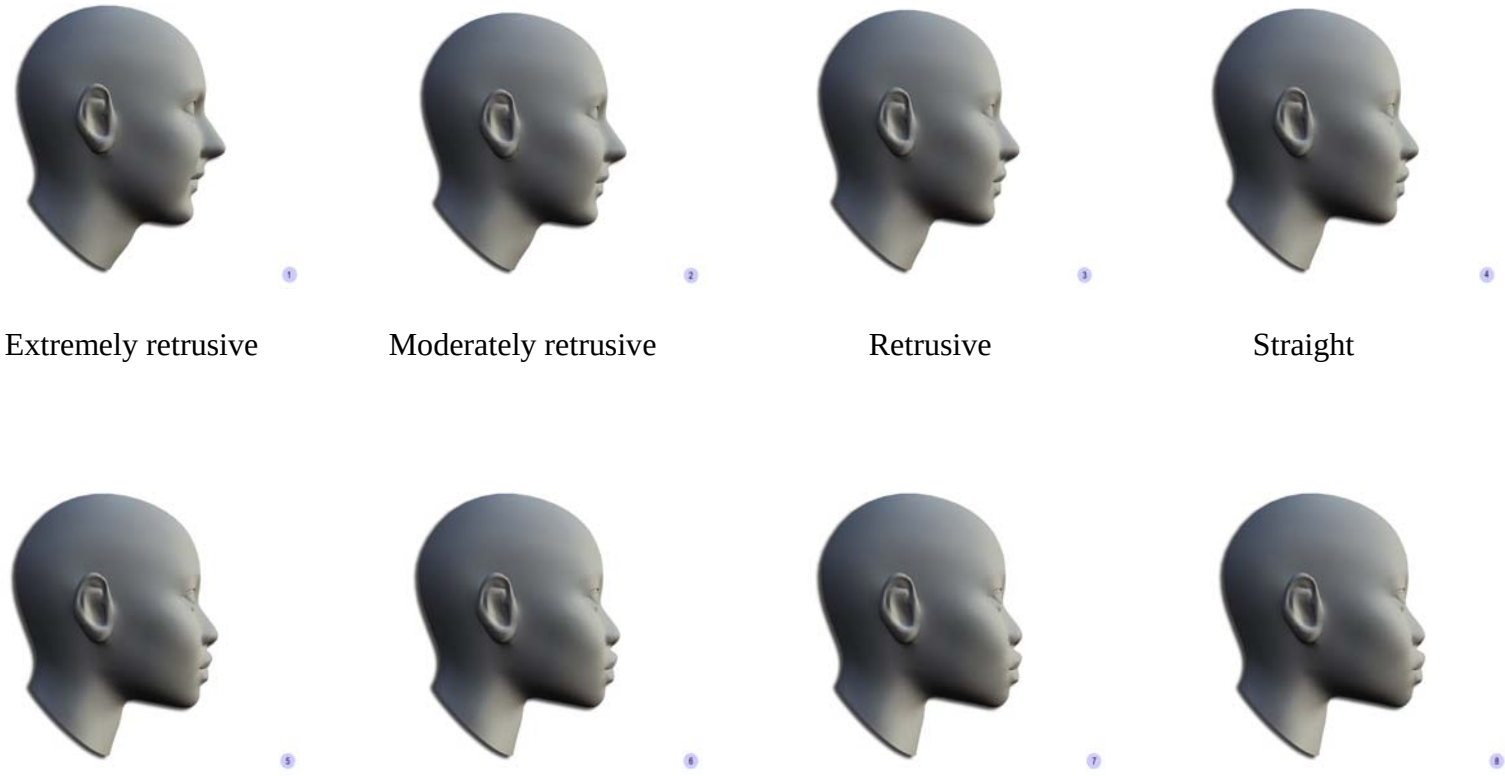

Figure 3.2.1 Morphed profile images used in this study

Each monochromatic high-resolution image (800 x 600 x 72 DPI) of A4 dimension was generated by an Epson® Stylus colour inkjet printer using Epson® Photoquality Glossy paper (S041126). Each image was individually laminated in a 125-micron gloss plastic encapsulation pouch and then arranged sequentially from number one to number eight in a horizontal series.

3.2.1 School learner, university student and school teacher study

An information sheet and an informed consent form were supplied to each participant prior to the interview session (see Appendix B). Once informed consent was obtained, participants were requested to complete a questionnaire containing specific information concerning their age, gender, race and category (school learner, university student or school teacher). The final part of the questionnaire required the participants to evaluate the eight sequentially arranged lateral profile images. Each respondent was asked to choose a single profile that was perceived to present the most attractive appearance overall, without focusing on any individual facial characteristic. No strict time limit for assessment of the images was enforced. However, care was taken to prevent participants from discussing their choice with other participants before recording their preference.

Sample size was expected to be determined by voluntary participation; however, the aim in this descriptive study was to at least exceed 300 subjects per group, ensuring a reliable statistical interpretation of the proportion of subjects demonstrating a preference for a particular degree of profile protrusiveness at a confidence level of 95% (nQuery Advisor 7.0).

3.3 STATISTICS

Data were analysed with the computer programme STATA (Version 10, StataCorp LP, College Station, Texas, USA) using frequency distributions, percentages, cross-tabulations, odds ratios and Pearson's Chi-square test.

Statistical significance was set at $P<0.05$.

CHAPTER 4: RESULTS

The total sample for this study comprised 2815 participants. There were 1798 school learners (63,9% of the total sample, 694 university students (24,7% of the total sample) and 323 school teachers (11,5% of the total sample). In general, there was greater female than male representation (Table 4.1).

Table 4.1 Frequency distribution of gender by sample group

Gender	School Learners		University Students		School Teachers		Total	
	n	%	n	%	n	%	n	%
Female	1068	59.40	471	67.87	229	70.90	1768	62.81
Male	730	40.60	223	32.13	94	29.10	1047	37.19
Total	1798	100	694	100	323	100	2815	100

$Chi^2 = 306.0461$ $P< 0.001$

With respect to race, the study groups apart from the university students, had greater representation of Whites than that of the other racial groups (Table 4.2).

Table 4.2 Frequency distribution of race by sample group

Race	School Learners		University Students		School Teachers		Total	
	n	%	n	%	n	%	n	%
Black	546	30.37	263	37.90	35	10.84	844	29.98
Coloured	169	9.40	26	3.75	9	2.79	204	7.25
Indian	181	10.07	165	23.78	11	3.40	357	12.68
White	902	50.16	240	34.58	268	82.97	1410	50.09
Total	1798	100	694	100	323	100	2815	100

$Chi^2 = 383.9304$ $P< 0.001$

With respect to the overall profile choices amongst the three sample groups, the most highly rated profile amongst all groups was the retrusive profile (number 3) (Table 4.3). There was a definite trend towards a preference for the more retrusive through to the straighter profiles (numbers 1 to 4). This is evidenced by the fact that for 83,48%, 82,28% and 94,74% of learners, university students and teachers respectively, these were the most popular choices. By contrast, only 16,52%, 17,73% and 5,27% of learners, university students and teachers respectively considered those profiles exhibiting mild to extreme protrusiveness (profile numbers 5 to 8) to be aesthetically pleasing (Table 4.3).

Furthermore, the distributions of learners, university students and teachers in their choices over the eight profiles differed significantly ($P< 0.001$). In particular, teachers were slightly more accepting of profiles exhibiting greater retrusion (Table 4.3).

Table 4.3 Frequency distribution of profile preference of school learners, university students and school teachers

Profile	School Learners		University Students		School Teachers		Total	
Number	n	%	n	%	n	%	n	%
1	152	8.45	22	3.17	40	12.38	214	7.60
2	280	15.57	76	10.95	77	23.84	433	15.38
3	562	31.26	256	36.89	130	40.25	948	33.68
4	507	28.20	217	31.27	59	18.27	783	27.82
5	169	9.40	90	12.97	12	3.72	271	9.63
6	63	3.50	19	2.74	3	0.93	85	3.02
7	28	1.56	7	1.01	2	0.62	37	1.31
8	37	2.06	7	1.01	0	0.00	44	1.56
Total	1798	100	694	100	323	100	2815	100

$Chi^2 = 114.1767$ $P< 0.001$

Further frequency distribution tables (Tables 4.14 and 4.15) representing the profile choices of private and public school learners and private and public school teachers appear in Appendix D.

The frequency distribution of the profile choices across the three study groups is demonstrated graphically in Figure 4.1.

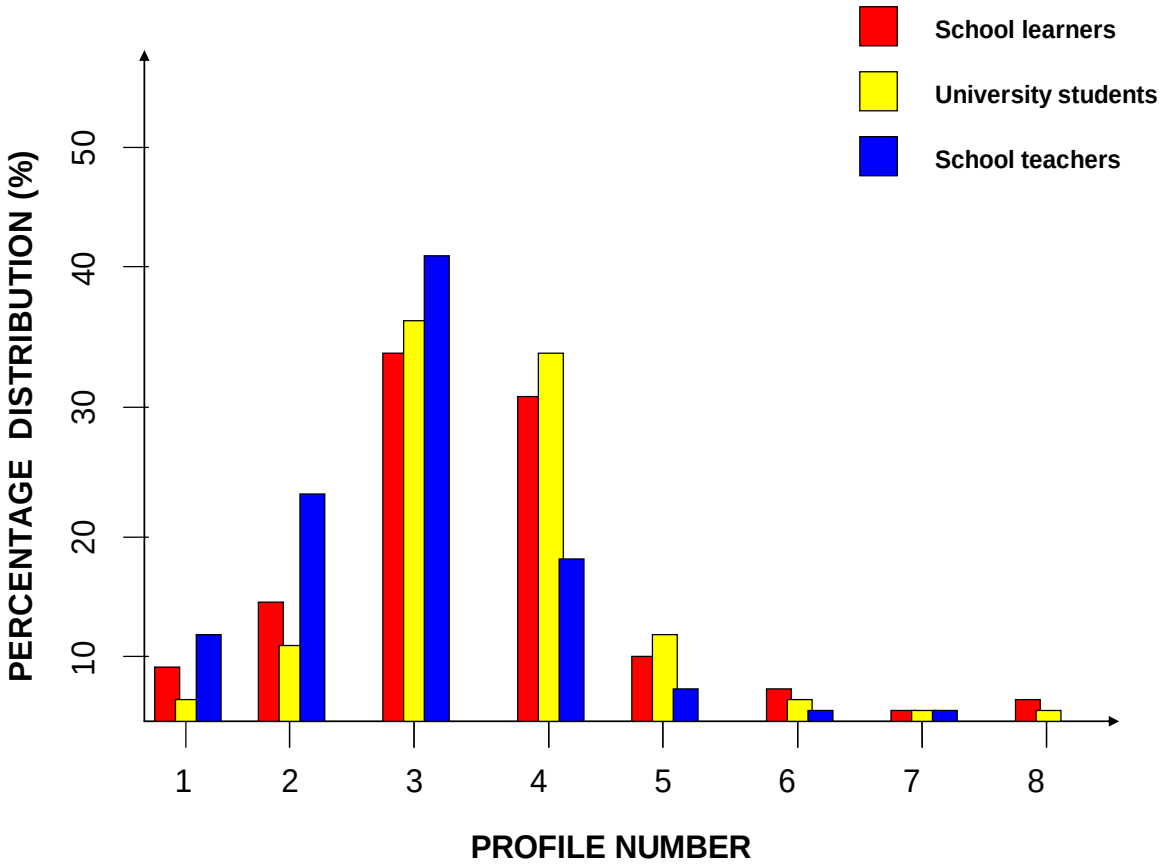

Figure 4.1 Frequency distribution of profile preference of school learners, university students and school teachers

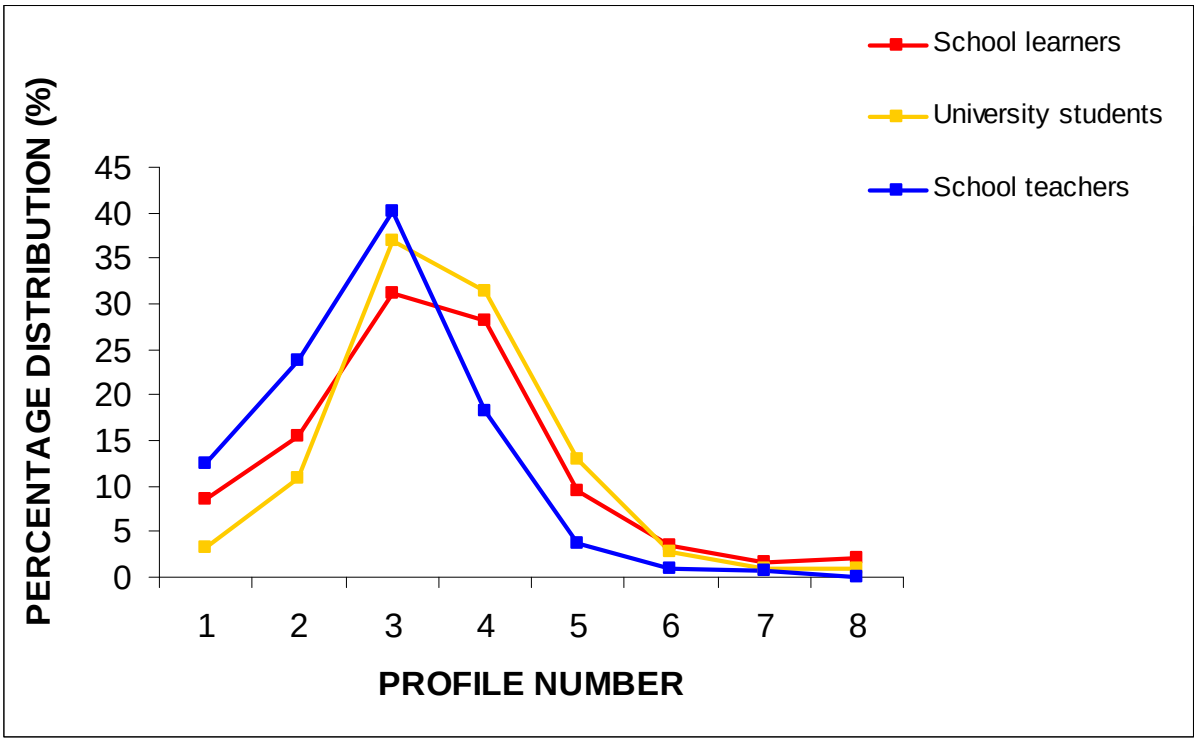

Figure 4.2 Frequency distribution of profile preference of school learners, university students and school teachers (although the results are not continuous, the lines have been joined for illustrative purposes)

There was marked similarity in the profile preferences of females. Across all three study groups, females considered the retrusive profile (number 3) the most pleasing followed by the straight profile (number 4) (Table 4.4).

Table 4.4 Frequency distribution of profile preference of female school learners, university students and school teachers

Profile	School Learners		University Students		School Teachers		Total	
Number	n	%	n	%	n	%	n	%
1	79	7.40	14	2.97	22	9.61	115	6.50
2	171	16.01	46	9.77	47	20.52	264	14.93
3	358	33.52	166	35.24	100	43.67	324	35.29
4	293	27.43	152	32.27	50	21.83	495	28.00
5	92	8.61	68	14.44	9	3.93	169	9.56
6	35	3.28	15	3.18	1	0.44	51	2.88
7	15	1.40	4	0.85	0	0.00	19	1.07
8	25	2.34	6	1.27	0	0.00	31	1.75
Total	1068	100	471	100	229	100	1768	100

$Chi^2 = 75.8677$ $P < 0.001$

Males on the other hand, were more variable in their choices, with the straight profile (number 4) the favoured profile amongst learners, the retrusive profile (number 3) most popular amongst university students and the teachers demonstrating an equal preference for both the moderately retrusive and the retrusive profiles (numbers 2 and 3 respectively) (Table 4.5).

Table 4.5 Frequency distribution of profile preference of male school learners, university students and school teachers

Profile	School Learners		University Students		School Teachers		Total	
Number	n	%	n	%	n	%	n	%
1	73	10.00	8	3.59	18	19.15	99	9.46
2	109	14.93	30	13.45	30	31.91	169	16.14
3	204	27.95	90	40.36	30	31.91	324	30.95
4	214	29.32	65	29.15	9	9.57	288	27.51
5	77	10.55	22	9.87	3	3.19	102	9.74
6	28	3.84	4	1.79	2	2.13	34	3.25
7	13	1.78	3	1.35	2	2.13	18	1.72
8	12	1.64	1	0.45	0	0.00	13	1.24
Total	730	100	223	100	94	100	1047	100

$Chi^2 = 65.2123$ $P < 0.001$

With respect to the profile choices of Black subjects across the three study groups, there was similarity in the choices of school learners and university students, with the majority demonstrating a preference for profiles 2 to 5 (moderately retrusive to mildly protrusive). Black teachers on the other hand, preferred the flatter profiles (numbers 1 to 4) (Table 4.6).

Table 4.6 Frequency distribution of profile preference of Black school learners, university students and school teachers

Profile	School Learners		University Students		School Teachers		Total	
Number	n	%	n	%	n	%	n	%
1	53	9.71	10	3.80	6	17.14	69	8.18
2	57	10.44	34	12.93	4	11.43	95	11.26
3	121	22.16	65	24.71	11	31.43	197	23.34
4	154	28.21	70	26.62	7	20.00	231	27.37
5	80	14.65	59	22.43	3	8.57	142	16.82
6	37	6.78	14	5.32	3	8.57	54	6.40
7	22	4.03	6	2.28	1	2.86	29	3.44
8	22	4.03	5	1.90	0	0.00	27	3.20
Total	546	100	263	100	35	100	844	100

$Chi^2 = 28.5633$ $P = 0.012$

Coloured school learners and university students had similar preferences with the moderately retrusive through to the straight profiles the most popular selections (profiles 2 to 4). However, meaningful inferences could not be made for the school teacher sample, owing to the limited sample size (Table 4.7).

Table 4.7 Frequency distribution of profile preference of Coloured school learners, university students and school teachers

Profile	School Learners		University Students		School Teachers		Total	
Number	n	%	n	%	n	%	n	%
1	9	5.33	2	7.69	2	22.22	13	6.37
2	28	16.57	3	11.54	0	0.00	31	15.20
3	56	33.14	8	30.77	5	55.56	69	33.82
4	53	31.36	11	42.31	1	11.11	65	31.86
5	15	8.88	0	0.00	0	0.00	15	7.35
6	4	2.37	2	7.69	0	0.00	6	2.94
7	3	1.78	0	0.00	1	1.11	4	1.96
8	1	0.59	0	0.00	0	0.00	1	0.49
Total	169	100	26	100	9	100	204	100

$Chi^2 = 19.3335$ $P = 0.153$

Indian school learners and university students likewise demonstrated the preference for the flatter profile (numbers 1 to 4 were the most preferred) while Indian teachers considered profiles 2 to 4 (moderately retrusive to straight) most appealing. Overall, the retrusive profile (number 3) was the preferred profile across all three groups (Table 4.8).

Table 4.8 Frequency distribution of profile preference of Indian school learners, university students and school teachers

Profile	School Learners		University Students		School Teachers		Total	
Number	n	%	n	%	n	%	n	%
1	30	16.57	4	2.42	0	0.00	34	9.52
2	41	22.65	20	12.12	2	18.18	63	17.65
3	53	29.28	81	49.09	5	45.45	139	38.94
4	41	22.65	48	29.09	4	36.36	93	26.05
5	12	6.63	10	6.06	0	0.00	22	6.16
6	1	0.55	1	0.61	0	0.00	2	0.56
7	0	0.00	0	0.00	0	0.00	0	0.00
8	3	1.66	1	0.61	0	0.00	4	1.12
Total	181	100	165	100	11	100	357	100

$Chi^2 = 37.1057 \quad P < 0.001$

Like the Indian sample, White school learners, university students and teachers also preferred the flatter profiles with the retrusive profile (number 3) the most popular amongst all three sample groups (Table 4.9).

Table 4.9 Frequency distribution of profile preference of White school learners, university students and school teachers

Profile	School Learners		University Students		School Teachers		Total	
Number	n	%	n	%	n	%	n	%
1	60	6.65	6	2.50	32	11.94	98	6.95
2	154	17.07	19	7.92	71	26.49	244	17.30
3	332	36.81	102	42.50	109	40.67	543	38.51
4	259	28.71	88	36.67	47	17.54	394	27.94
5	62	6.87	21	8.75	9	3.36	92	6.52
6	21	2.33	2	0.83	0	0.00	23	1.63
7	3	0.33	1	0.42	0	0.00	4	0.28
8	11	1.22	1	0.42	0	0.00	12	0.85
Total	902	100	240	100	268	100	1410	100

$Chi^2 = 80.3300 \quad P < 0.001$

In addition to frequency distribution tables, odds ratios were also evaluated. The odds ratio is a descriptive statistic which describes the strength of association or non-independence between two data values. Unlike other measures of association such as the relative risk, the odds ratio treats the two variables being compared symmetrically, and therefore can also be estimated using non-random samples. The odds ratio is the ratio of the odds of an event occurring in one group to the odds of it occurring in another group, and is a sample-based estimate of that ratio. These groups might be men and women, an experimental group and a control group, or any other dichotomous classification.

In the school learner sample, two age categories were created. The first or reference category comprised learners up to the age of 12 years; the second category comprised learners aged 13 years and older. The profiles were then categorized as retrusive (numbers 1 to 4) and

protrusive (numbers 5 to 8). When compared with the reference group of learners (learners ≤ 12 years of age), the 13 years-and-older learners were 0,681-fold as likely to demonstrate the same preference for profile protrusiveness. For the odds ratio the trend over age was statistically significant (*P*= 0.0044) (Table 4.10).

Table 4.10 Odds ratios of profile preference by age of school learners

Age Category	Odds Ratio
≤ 12 years	1.000
≥13 years	0.681

P= 0.0044

Similarly, odds ratios were calculated for age ranges in both the university student and school teacher samples. For the university group, the age ranges were 18 years and less for the reference category and 19 years and above for the second category. The odds of university students aged 19 years and older preferring facial protrusiveness was 1,248-fold that of the reference group (university students aged 18 years and less). However, for the odds ratio the trend over age was not statistically significant (*P*= 0.2678) (Table 4.11).

Table 4.11 Odds ratios of profile preference by age of university students

Age Category	Odds Ratio
18 years and <	1.000
19 years and >	1.248

P= 0.2678

With respect to the sample of school teachers, three age groups were used (teachers up to 30 years of age; teachers aged 31-45 years; and teachers > 45 years of age). While the odds that teachers between the ages of 31 and 45 years would prefer a more protrusive profile were very small, adult teachers above the age of 45 years were 1,435 times more likely to demonstrate a preference for facial protrusiveness when compared with the reference group (teachers aged 30 years and less). Once again, for the odds ratio the trend over age was not statistically significant (*P*= 0.6071) (Table 4.12).

Table 4.12 Odds ratios of profile preference by age of school teachers

Age Category	Odds Ratio
≤ 30 years	1.000
31-45 years	1.081
>45 years	1.435

P= 0.6071

Further odds ratio tables (Tables 4.16-4.19) outlining the profile choices of private and public school learners and school teachers by age appear in Appendix E.

On evaluating the influence of race on profile preference and using the preferences of the Indian subset as a reference, Whites in the study sample were slightly more likely to prefer facial protrusiveness (1.203 odds ratio). Coloureds however, were 1.716-fold as likely to find a protrusive profile acceptable. Blacks could categorically be expected to find a protrusive profile appealing (5.000 odds ratio). The trend in odds ratio over racial groups was statistically

significant ($P< 0.001$), increasing from Indian to Whites to Coloureds and finally to Blacks (Table 4.13).

Table 4.13 Odds ratios of profile preference by race of study sample

Race Category	Odds Ratio
Indian	1.000
White	1.203
Coloured	1.716
Black	5.000

$P< 0.001$

CHAPTER 5: DISCUSSION

Little appears in the literature regarding, firstly, the perception of facial attractiveness amongst South Africans and secondly, whether a difference exists that is based on age. These questions formed the basis for this research.

Stimulus images have previously been presented in a multitude of guises ranging from paper or wood or acrylic cutouts (Hershon and Giddon, 1980), line drawings (Riedel, 1957; Prahl-Andersen *et al.*, 1979), photographs (Peck and Peck, 1970; Kerr and O'Donnell, 1990), silhouette profiles (Lines, Lines and Lines, 1978; De Smit and Dermaut, 1984), artist sketches (Kinnebrew, Hoffman and Carlton, 1983; Burcal, Laskin and Sperry, 1987) and more recently, digitally morphed discrete or animated renditions (Giddon 1996a, 1997), each with their own advantages, disadvantages and biases. Alley and Hildebrandt (1988) are of the opinion that representations such as line drawings and artist sketches in addition to often being unrealistic in their depiction of facial form, are subject to considerable distortion. Others, such as cutout models and animated morphed images require manipulation by the subject and rely on the person's psychomotor ability which has been shown to vary considerably between individuals (Giddon, Hershon and Lennartsson, 1974). Photographs and digitally morphed images of actual subjects, although more realistic, have many facial traits such as skin texture and complexion, hair colour and style, differences in nasal morphology, makeup and adornments which can influence the assessment of a facial profile. The development and application of the research tool described in this research report has been reported previously (Morar, 2007). Many of the shortcomings of the other modes of stimulus presentation highlighted above have been addressed by intentionally removing potential distracting variables. The initial creation of

a set of digitally-rendered master images and their subsequent morphing/warping has resulted in the generation of a subset of stimulus images which are standardised in respect of cranial morphology, texture, colour and scale. The final set of eight sample images was intentionally restricted to grayscale in order to negate possible bias due to the influence of skin complexion and texture. This rendered the instrument broadly applicable to all ethnic and racial groups thereby permitting cross-cultural investigation and comparison of results.

A review of the number, method and duration of stimulus image presentation in previous investigations has revealed marked variability. Maple, Vig, Beck *et al.* (2005) presented 36 profile photographs twice each to 150 judges. Hier, Evans, BeGole *et al.* (1999) displayed 29 digitally-altered lateral profile male and a similar number of altered female images ranging from the most retrusive to the most protrusive lip position to 58 judges. Hall *et al.* (2000) used 60 silhouette profiles based on the cephalometric tracings of 30 African-American and 30 White patients between the ages of seven and 17 years which they presented to 38 orthodontists and 40 laypersons for assessment.

Variability also existed with respect to the amount of time permitted to complete some of the appraisals. Some investigations used as many as 240 slides or photographs in their assessment of facial attractiveness (Kerr and O'Donnell, 1990; Tatarunaite *et al.*, 2005) which took approximately 45 minutes to complete or were completed at home and returned a week later by the judges. Burcal, Laskin and Sperry (1987) presented 20 pairs of male and female photographs first sequentially, then in reverse order with a five second viewing time allowed for each photograph. Michiels and Sather (1994), on the other hand, had eight 40 minute viewing sessions. In the first session, 18 randomly selected and ordered photographic slides

were displayed. In each subsequent session, 16 new randomly selected slides were presented together with two randomly chosen slides from previous viewing sessions.

The current study utilised a smaller number of stimulus images, presented in an ordered arrangement to enable a more reliable and logical assessment of the facial profile. Compared with the random presentation of many images, the sequential presentation of a limited number of images allowed the eye to follow a progressive change in the facial profile. This had the potential to reduce fatigue and guesswork which may otherwise have accompanied the evaluation of a large number of randomly presented images. Attention was also given to ensuring that features such as the upper third of the face, top and back of the head, ears and neck remained unchanged.

In addition to the wide variety of research instruments previously employed, investigations have generally used gender-specific images to assess the profile preferences of males and females. Czarnecki, Nanda and Currier (1993) constructed a series of androgynous silhouette profile images in order to assess the perceptions of a balanced facial profile. Although a large number of images was presented (six rows of images with seven silhouette profiles in each row), they were found to be equally applicable to both males and females. The current study, similarly, made use of a series of digitally morphed androgynous lateral profiles which negated the need for a larger number of gender-specific images and permitted ready comparison between male and female subjects.

Previous investigations have also assessed gender-based differences in soft tissue profile preferences. However, conflicting reports appear in the literature. Foster (1973), Czarnecki,

Nanda and Currier (1993) and Hier *et al.* (1999) all demonstrated a female preference for fuller lips for both males and females. Polk *et al.* (1995) studied 150 African-Americans of varying ages, social and educational backgrounds to evaluate their personal soft tissue profile preference. Their findings indicated that male and female subjects preferred relatively flat profiles. This was in agreement with other investigations which concluded that both Whites and African-Americans preferred straighter profiles but that these were not necessarily as flat as the typical White profile (Martin, 1964; Thomas, 1979; Farrow, Zarrinnia and Azizi, 1993). Hall *et al.* (2000) on the other hand, showed that White Americans and African-Americans preferred greater profile convexity and lip prominence in the African-American profile while Yehezkel and Turley (2004) demonstrated the trend during the twentieth century towards the preference for fuller and more anteriorly positioned lips amongst African-Americans. These observations conflict with the findings of this study which demonstrated the greater appeal of the flatter facial profiles and concomitant lack of support in the sample for those profiles exhibiting protrusiveness (Table 4.3). With respect to gender, the findings of this study indicated that males and females were similar in their choice of the preferred facial profile (Tables 4.7 and 4.8). This was in agreement with the findings of Polk *et al.* (1995) and Morar (2007) who demonstrated the preference of both males and females for relatively flat facial profiles.

A noteworthy finding of this study was the consensus amongst the peer groups regarding the relative unattractiveness of the images representing the extremes of profile protrusiveness and retrusiveness (Tables 4.1 to 4.4). This observation lends support to the arguments of evolutionary theorists and others who believe that ‘average’ faces are beautiful (Edler, 2001). On the other hand, there remains great individual variation in the perception of facial

attractiveness, as evidenced by the considerable support amongst the peer groups for profiles ranging from the extremely retrusive (profile number 1) to the straight (profile number 4) (Table 4.3). Appropriate attention should therefore be paid to the importance of individuality in the evaluation of facial attractiveness.

While some investigators are of the opinion that the perception of facial attractiveness is essentially similar across different cultures and age groups (Iliffe, 1960; Udry, 1965; Perrett, May and Yoshikawa, 1994), others have suggested that children as young as three months old are able to discriminate between attractive and unattractive faces (Samuels and Ewy, 1985; Langlois *et al.*, 1987). The perception of facial attractiveness therefore appears to have a significant biological basis and is not merely a product of socio-cultural norms. The findings of the present study corroborate these assertions- across the three age groups, the odds of protrusiveness being favoured with increasing age was found to be statistically significant only in the school learner sample (Tables 4.15, 4.16 and 4.19). Based on this finding, one can speculate that aesthetic perceptions are shaped relatively early in life, are fluid to some extent until early adulthood but remain relatively static with advancing age.

The findings of this study also indicated clear differences in profile preferences with respect to ethnicity- Blacks found a protrusive profile to be more appealing when compared with the choices of Indians and Whites (Table 4.20). This finding was in contrast to those of Perrett, May and Yoshikawa (1994) who argued that aesthetic perceptions are similar irrespective of age, gender and cultural background.

Recent investigations involving neural modulation of face processing abilities suggested that face processing undergoes a gradual maturation during development (Taylor, McCarthy, Saliba *et al.*, 1999). In addition, Nakamura, Kawashima, Nagumo *et al.*, (1998) have provided evidence implicating the left frontal lobe of the brain in judgements of facial attractiveness. This information suggested a role for neurological developmental factors in the perception of facial aesthetics as the frontal lobes are areas of the brain which are subject to significant modification during the course of development.

Although it is recognized that faces are a special class of visual objects, it is also clear that discrimination and recognition of faces change with development. For instance, children are less able to correctly associate photographs of a person taken 20 years apart. This prompted Carey (1992) to suggest that age-related differences in face-processing could be attributed to the fact that children rely more on isolated facial features than on the configurational information present in a face. Ellis and Flin (1990) on the other hand suggested that older individuals are simply able to extract more information from a face in a given time period.

While there is considerable knowledge regarding infants' abilities to perceive facial attractiveness and the socio-cultural consequences of dentofacial aesthetics, very little is known about the extent to which child and adult preferences differ or if they differ at all. Kissler and Bauml (2000) for instance, demonstrated no difference in the aesthetic preferences of nine year olds, twelve year olds and adults in their assessments of girl's and women's faces. The observations of the present study are in partial agreement which those findings, having demonstrated statistically significant age-related differences in the facial profile preferences only in the school learner group (Table 4.15).

Phillips, Tulloch and Dann (1992) suggested that the simultaneous presentation of frontal and profile views would allow the most complete visualization of the facial form, a concept which has been applied by Knight and Keith (2005) and Kiekens, Maltha, van't Hof *et al.* (2005). This suggestion lends itself to the use of three-dimensional facial assessments in future studies.

Others have tried to identify isolated physical features that could differentiate attractive from unattractive faces (Baudouin and Tiberghien, 2004). However, the precise relationship between morphological changes and the aesthetic judgements thereof have not been clearly defined (Giddon *et al.*, 1996a). The role of specific morphological traits in the perception of facial attractiveness therefore remains unclear (Phillips, Tulloch and Dann, 1992; Phillips, Griffin and Bennett, 1995). It is ultimately the perception and not the actual physical characteristics to which the person is responding and which he or she may not be able to communicate in a cognitive or emotional sense (Giddon *et al.*, 1996a). Investigations have also shown that it is more difficult to draw conclusions regarding the influence of particular facial features on the perception of facial aesthetics when several features are altered simultaneously (Hier *et al.*, 1999; Faure, Rieffe and Maltha, 2002). Future like-minded studies should therefore alter facial features individually in order to obtain more information regarding the relative importance of the various facial features on one's perception of ideal aesthetics. According to Carey (1992) and Kissler and Bauml (2000), children are less sensitive to the variations present in faces compared with adults, and may rely more on isolated features than on configurational aspects. This may explain differences in perception of facial attractiveness on the basis of age, as demonstrated in the findings of this study.

More recently, geometric morphometrics, a method for the multivariate statistical analysis of shape, has been used to measure geometric averageness and sexual dimorphism of natural female facial profiles (Valenzano, Mennucci, Tartarelli *et al.*, 2006). Their findings confirmed both the close correlation of averageness and sexual dimorphism with attractiveness as well as the fact that exaggerated secondary sexual traits are indicators of phenotypic and higher heritable fitness as reported previously in the literature (Langlois and Roggman, 1990). Wong, Karimi, Devcic *et al.* (2008) described the use of a 'genetic algorithm' in combination with morphing software and focus-group derived attractiveness scores to synthetically evolve attractive faces. The algorithm used as its basis the tenet of natural selection that biased the digital process towards the selection of more attractive faces. According to the authors, the absence of this selective pressure resulted in images exhibiting only average features. These two methods provide a glimpse into the future directions of facial aesthetics research.

There are currently no studies in the literature investigating age-related differences in the profile preferences of South Africans with which the findings of this study could be compared. It is hoped that future studies of a similar nature will provide the data to permit such comparisons.

CHAPTER 6: CONCLUSIONS

1. The findings of this study support the hypothesis that age is a factor in the perception of facial attractiveness particularly amongst individuals of school-going age. Thereafter, advancing age does not exert a significant influence on the perception of profile preference.
2. There was a definite overall preference for the less protrusive facial profiles in the three sample groups.
3. The same preference for less profile protrusiveness was found for males and females in the three sample groups.
4. Clear ethnic differences in profile preference were demonstrated where Blacks preferred a greater degree of protrusiveness when compared with the selections made by Indians, Coloureds and Whites.

APPENDIX A: List of abbreviations used in text and tables

Chi^2	Chi-square
P	Probability
%	Percentage
n	Number of participants
N	Total number of participants

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Morar

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M071169**
PROJECT	Age-Related Differences in the Perception of Facial attractiveness in South Africans (Originally Approved as Protocol M040412)
INVESTIGATORS	Dr A Morar
DEPARTMENT	Dept of Orthopaedics
DATE CONSIDERED	07.11.12
DECISION OF THE COMMITTEE*	

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE **CHAIRPERSON** .....
(Professors PE Cleaton-Jones, A Dhai, M Vorster, C Feldman, A Woodiwiss)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor :

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

INFORMATION SHEET FOR PARENTS OF SCHOOL LEARNERS

Dear Parent

I am Dr. Morar, a postgraduate student from the WITS School of Oral Health Sciences Orthodontic Department and am investigating what type of faces South Africans find attractive, as part of my training.

Why we are doing this ?
Orthodontic research from the developed nations has shown that males and females of different ages find different faces attractive. We don't know to what extent this is true in South Africa. We are hoping that this study will help us to answer this question, and invite you to allow your child to participate in my study.

How are we going to do this ?
We have chosen 8 pictures of faces, which will all be shown simultaneously. Each child will be given a questionnaire to complete requesting details such as his/her age and gender. In addition, the form will have a box in which he/she will mark the particular face they consider the most attractive. The entire process should take between 5 to 10 minutes to complete.

How and why are you being invited to participate ?
Your child is being invited to participate because of his/her age and gender.

Is it private ?
The information on the form will be kept anonymous. Your child will not be required to supply any personal information besides his/her age and gender.

Is it safe ?
This same technique has been used in many similar studies. There are no risks or complications if your child decides to participate.

May my child withdraw from the study ?
Your child's participation is completely voluntary. He/she may withdraw from the study at any stage without being penalized and will not have to furnish reasons for his/her withdrawal. Your child will not be forced to participate even if he/she changes his/her mind after having agreed initially. Furthermore, no-one at your child's school will know who participated.

Where can I find out more ?

If you have any queries or need more information please contact Dr. A Morar at telephone number (011) 488 4858 (w) or 082 880 8206 (cell).

If you are willing to allow your child to participate in my study, please read and sign the attached consent form.

Thank you,

Dr. A. Morar

C / APPENDIX

INFORMATION SHEET FOR SCHOOL LEARNERS

Hello,

I am Dr. Morar, a trainee orthodontic student from the WITS Dental School. I am doing some research in order to understand what type of faces learners such as you find attractive.

Why we are doing this ?
Research from the USA and Great Britain has shown that boys and girls of different ages find different faces attractive. We don't know if this is true in South Africa and are hoping that this study will help us to answer this question, and invite you to participate in my study.

How are we going to do this ?
We have chosen 8 pictures of faces, which will all be shown simultaneously. Each person will be given a questionnaire to complete requesting details such as your age, sex, etc. In addition, the form will have a box in which you will mark the particular face that you consider the most attractive. The entire process should take between 5 to 10 minutes to complete.

How and why are you being invited to participate ?
You are being invited to participate because of your age and sex.

Is it private ?
The information on the form will be kept anonymous. We don't need any other information besides your age and gender.

Is it safe ?
This same type of study has been used by many other researchers. There are no risks or complications if you decide to participate.

May I withdraw from the study ?
Your participation is completely voluntary. You may withdraw from the study at any time. You will not be penalized. You will not have to explain why you changed your mind. You will not be forced to participate even if you change your mind after saying yes in the beginning.

Where can I find out more ?
If you need any information or have any questions, please contact me, Dr. A Morar at telephone number (011) 488 4858 (w) or 082 880 8206 (cell).

If you want to participate in the study, please read and sign the attached consent form.
Thank you,

Dr. A. Morar

INFORMATION SHEET FOR SCHOOL TEACHERS AND UNIVERSITY STUDENTS

Hello,

I am Dr. Morar, a postgraduate student from the WITS School of Oral Health Sciences Orthodontic Department and am investigating what type of faces South Africans find attractive, as part of my training.

Why we are doing this ?
Orthodontic research from the developed nations has shown that males and females of different ages find different faces attractive. We don't know to what extent this is true in South Africa. We are hoping that this study will help us to answer this question, and invite you to participate in my study.

How are we going to do this ?
We have chosen 8 pictures of faces, which will all be shown simultaneously. Each person will be given a questionnaire to complete requesting details such as your age, sex, etc. In addition, the form will have a box in which you will mark the particular face that you consider the most attractive. The entire process should take between 5 to 10 minutes to complete.

How and why are you being invited to participate ?
You are being invited to participate because of your age and sex.

Is it private ?
The information on the form will be kept anonymous. You will not be required to supply any personal information besides your age and gender.

Is it safe ?
This same technique has been used in many similar studies. There are no risks or complications if you decide to participate.

May I withdraw from the study ?
Your participation is completely voluntary. You may withdraw from the study at any stage without being penalized. You will not have to explain the reason for your withdrawal. You will not be forced to participate even if you change your mind after having agreed initially.

Where can I find out more ?

If you have any queries or need more information please contact Dr. A Morar at telephone number (011) 488 4858 (w) or 082 880 8206 (cell).

If you are willing to participate in the study, please read and sign the attached consent form.

Thank you,

Dr. A. Morar

C / APPENDIX

INFORMED CONSENT FORM FOR PARENTS OF SCHOOL LEARNERS

I consent to my child's participation in the following study. I recognize that this is for research purposes and not for any treatment that may provide personal benefit. There are no risks involved and I am free to withdraw my child at any stage even if I initially granted consent. I understand that I am under no obligation to give reasons nor will my child be penalised if he/she decides to withdraw.

I declare that I have read the above and hereby give my consent to allow my child to participate in this study.

_____ _____

Name: Signature:

_____

Date:

INFORMED ASSENT FORM FOR SCHOOL LEARNERS

I wish to participate in your study. I know that this is for research and not for any personal treatment which may help me. There are no risks involved and I am free to change my mind and withdraw from your study at any time. I understand that I will not have to give reasons nor will I be penalised if I decide to withdraw.

I have read the above and hereby give my consent to participate in your study.

_____ _____

Name: Signature:

_____

Date:

C / APPENDIX

INFORMED CONSENT FORM FOR SCHOOL TEACHERS AND UNIVERSITY STUDENTS

I consent to participate in the following study. I recognize that this is for research purposes and not for any treatment that may provide personal benefit. There are no risks involved and I am free to withdraw at any stage even if I initially agreed to participate. I understand that I am under no obligation to give reasons nor will I be penalised if I decide to withdraw.

I declare that I have read the above and hereby give my consent to participate in this study.

_____ _____

Name: Signature:

_____

Date:

C / APPENDIX

QUESTIONNAIRE FOR PARTICIPANTS

N.B. Please circle or underline what applies to you

Age: _____years

Gender: Male / Female

Race: Black / Coloured / Indian / White

Category: School learner / University student / School teacher

- Before you are pictures of 8 faces.
- Take as long as you like to look at them.
- Thereafter, in the box below, please mark the number of the face that you consider to be the most attractive.
- Choose only one face and write down its number.
- Do not look at any particular feature; rather choose a face that appears to be the most attractive overall.
- Thank you for your participation.

Picture number :

Table 4.14 Frequency distribution of profile preference of school learners by type of school

Profile	Private Learners		Public Learners		Total	
Number	n	%	n	%	n	%
1	55	6.77	97	9.85	152	8.45
2	138	16.97	142	14.42	280	15.57
3	242	29.77	320	32.49	562	31.26
4	254	31.24	253	25.69	507	28.20
5	74	9.10	95	9.64	169	9.40
6	21	2.58	42	4.26	63	3.50
7	15	1.85	13	1.32	28	1.56
8	14	1.72	23	2.34	37	2.06
Total	813	100	985	100	1798	100

$Chi^2 = 18.1437$ $P = 0.011$

Table 4.15 Frequency distribution of profile preference of school teachers by type of school

Profile	Private Teachers		Public Teachers		Total	
Number	n	%	n	%	n	%
1	9	6.08	31	17.71	40	12.38
2	25	16.89	52	29.71	77	23.84
3	68	45.95	62	35.43	130	40.25
4	32	21.62	27	15.43	59	18.27
5	10	6.76	2	1.14	12	3.72
6	3	2.03	0	0.00	3	0.93
7	1	0.68	1	0.57	2	0.62
8	0	0.00	0	0.00	0	0.00
Total	148	100	175	100	323	100

$Chi^2 = 28.5440$ $P < 0.001$

Table 4.16 Odds ratios of profile preference by age of private school learners

Age Category	Odds Ratio
≤ 12 years	1.000
≥13 years	0.686

P= 0.0623

Table 4.17 Odds ratios of profile preference by age of public school learners

Age Category	Odds Ratio
≤ 12 years	1.000
≥13 years	0.597

P= 0.0065

Table 4.18 Odds ratios of profile preference by age of private school teachers

Age Category	Odds Ratio
≤ 30 years	1.000
31-45 years	0.693
>45 years	0.565

P= 0.5534

Table 4.19 Odds ratios of profile preference by age of public school teachers

Age Category	Odds Ratio
≤ 30 years	1.000
31-45 years	0.505
>45 years	1.885

P= 0.7247

1

Extremely retrusive profile

2

Moderately retrusive profile

3

Retrusive profile

4

Straight profile

5

Mildly protrusive profile

6

Moderately protrusive profile

7

Protrusive profile

8

Extremely protrusive profile

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