THE DEVELOPMENT OF AN ORTHODONTIC SCREENING METHOD

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A thesis submitted in partial
requirement for the degree of
MDSc.

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ABSTRACT

This thesis aimed to develop an orthodontic screening method suitable for use for schoolchildren in country areas serviced by the State Orthodontic Service of New South Wales.

A total of 321 children, aged 10 to 12 years of age, were surveyed using the Dental Aesthetic Index and a self-assessment questionnaire designed and developed to gather information concerning the children's self-image of their dento-facial aesthetics.

The overall results obtained indicated the existence of a significant relationship between the scores obtained from the Dental Aesthetic Index and those scores derived from the self-assessment questionnaire.

The main conclusion reached from this study was that the combined use of the Dental Aesthetic Index with an appropriate self-image questionnaire as a screening tool for the State Orthodontic Service seems worthy of further development.
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DEDICATION

I dedicate this thesis to my wife and best friend, Barbara, and to my children, Evelyn, Louise, and Aiden.

I thank them for their patience and understanding, and am indebted for the tolerance they have shown me during the last three years.

I know I can make up for the time we have lost.
ACKNOWLEDGEMENTS

The completion of this thesis involved the help of many talented people, and it gives me pleasure to be able to give due acknowledgement to the following.

1. Associate Professor Keith Godfrey, Orthodontic Department, United Dental Hospital, University of Sydney, and Director of the State Orthodontic Service, New South Wales. I wish to thank 'Prof' for his personal inspiration, wise guidance, and gentlemanly scholarship. I also thank Prof for the invaluable help and guidance he provided during the supervision of this thesis and during the entire Masters Course. I am indebted.

2. Dr Kathryn Arneman, Dental Surgeon, Graduate student in Orthodontics, Sydney University. I thank Kath for volunteering, at her own expense, to be the second examiner in the main field survey of this thesis. Kath's help and suggestions were invaluable, her expertise undoubted, and her enthusiasm unbounded. Kath, thank you for your friendship, your support, your sense of humour, and your willingness to share in practical jokes. I owe you.

3. Dr Alan Patterson, Principal Dental Officer, New England Health Region, New South Wales. I wish to thank Alan and acknowledge his help and support in the thesis field studies. Alan willingly provided the staffing support, clinical facilities, and transport in the New England Area that made this thesis survey so straightforward.
4. Dr Michael Snow, Orthodontist, Senior Lecturer in Orthodontics, United Dental Hospital, University of Sydney. I wish to thank Mike for his enthusiastic support and helpful suggestions in the writing of this thesis.

5. Mrs Fiona Budd (Dental Therapist) and Mrs Valda Bryant (Dental Assisant) deserve particular thanks for their willingness to help and their professional assistance in the field survey, and also for their continuing significant contribution towards the smooth running of the State Orthodontic Service, New England Health Region.

6. All the Dental Staff of the New England Health Region, for their personal and professional support both for me and the State Orthodontic Service over the two years I have worked in Tamworth. Many people contributed to the thesis field survey in different ways, but specifically I wish to thank Dr T. Alymer (Dental Surgeon), Mrs R. Rogers (Senior Dental Therapist), Mrs L. Haack (Senior Dental Therapist), Miss V. Nebeaur (Senior Dental Therapist), Miss K. Hatch (Dental Assistant), Mrs D. Maher (Dental Assistant).

7. Dr Robert Mylchreest, Orthodontist and friend, for encouragement and help. I thank Rob for his memorable company at Tamworth's dining establishments.

8. Members of the Child Development Unit of the Community Health Centre, Tamworth, for their feedback and comments concerning the thesis questionnaire.
9. Mr Gary Barton (Teacher in Computer Science), a good friend and talented computer 'whiz kid'. Much thanks is owed to Gary for the extraordinary patience and helpfulness shown to me in the set-out of this thesis.

10. Dr A. Kirby, PhD. (Statistician, Department of Biometrics, University of Sydney). I wish to thank Dr Kirby for her expert advice concerning the statistical design and statistical interpretation of the results of this thesis.

11. My classmates, Dr Steven Duncan, Dr Alan Ward, Dr Peggy Kittipibul, and Dr Rosi Wihardja. Thank you for your friendship, your humour, your encouragement, and good times shared. Good luck to you all.

12. My long suffering relatives and friends, for all their support and tolerance. Special thanks to John and Lib Reilly for their strength and unqualified and practical support for Barbara and the children during my many trips to Tamworth.
AIM

The primary aim of this thesis was to develop an orthodontic screening method that could be used to place patients on a treatment waiting program of the State Orthodontic Service (New England Health Region) with a defendable priority ordering.

In the process of meeting this primary aim, this thesis aimed to develop a questionnaire which could assess and quantify a patient's need and desire for orthodontic treatment and to compare that need and desire with an objective measure of that patient's occlusion using an established occlusal index.
CHAPTER ONE

INTRODUCTION

The increasing demands for publicly funded orthodontic treatment for the New South Wales community, coupled with the inability to meet those demands due to the limited resources available give rise to a number of problems. The problems revolve around the unfortunate fact that the public demand for orthodontic care exceeds the resources of the public health system to deliver the care.

The State Orthodontic Service is one of the publicly funded bodies in New South Wales which provides specialist orthodontic care to holders of Health Care Cards and their dependants (i.e. to those people assessed by the Department of Social Security to be entitled to free medical or dental treatment due to their disadvantaged economic and/or health circumstances).

The report of the State Orthodontic Service for January to December 1990 by its Director, Associate Professor K. Godfrey, stated that:

"There are considerably more patients referred to the clinics than can be immediately attended to. It has been necessary to advise first-time attending patients that they can likely expect waiting periods as long as one to two years depending upon the size of the local indigent population".

The State Orthodontic Service presently operates a number of clinics throughout New South Wales, with each clinic serving its local health area.
These clinics are located at:
Tamworth,
Wagga,
Dubbo,
Orange,
Newcastle,
Goulburn,
Queanbeyan,
Coffs Harbour, and
Albury.

These clinics are mainly staffed by orthodontic registrars currently undertaking training in the Masters Degree Course in Orthodontics of the University of Sydney at the United Dental Hospital, Sydney, New South Wales.

Some of the State Orthodontic Service clinics also employ visiting registered orthodontists on a part-time basis. All the clinics operate on a part-time basis, usually four (4) working days every fourth week.

Support staff for each clinic is obtained through the personnel currently working at those clinics and employed by the Regional and Area Health Boards. The support staff are arranged through the assistance of the Principal Dental Officer of each respective Health Region.

Where orthodontic treatment is financed through a public institution or other similarly accountable source, such as the State Orthodontic Service, it is reasonable to expect that some type of defendable screening process is required for the discretionary delivery of such care.
Therefore, a defendable order of orthodontic treatment priority based on the severity of the patient's orthodontic problem should be employed. Such a treatment priority order should be soundly based, meeting the approval of both those responsible for supplying the finance required to run the service and also of those patients who may have been assigned a lesser priority on the treatment waiting list.

Various occlusal indices have been developed which aim to measure, with objectivity and reliability, occlusal parameters of occlusion. However, factors other than the occlusal index assessment of a person's perceived malocclusion should be considered in relation to objective treatment priority as indicated through an occlusal index. A variety of those factors relevant to the assessment of need for orthodontic treatment can only be assessed subjectively by the orthodontist or general dentist.

The need for treatment, for example, must depend to a large extent on the patient's own attitude to their malocclusion both from an aesthetic point of view and from its importance to their everyday life. If a person's emotional health is affected or compromised by a malocclusion this should be able to be measured in some way. Simply because research of emotional health has many difficulties one should not let this be sufficient dissuasion from undertaking such research.

A number of authors have researched the psychosocial aspects of malocclusion and its effect on the individual.
Shaw (1981,a) wrote:

"A review of the literature regarding the social implications of dentofacial anomalies reveals a paucity of systematic research".

Shaw (1981,b) concluded that:

"While awaiting the outcome of further research in real life settings where true interaction has taken place, it seems reasonable to anticipate that dentofacial anomalies of sufficient severity to mar a child's facial attractiveness may represent an important social disadvantage".

The majority of measures of orthodontic treatment priority are based on clinical examinations.

Few attempts have been made to measure or record the perceptions of the child/patient or the patient's parent in relation to disability or handicap resulting from malocclusion. Yet these subjective elements are the most important determinants of the demand for orthodontic treatment (Baldwin and Barnes 1966).

Such social and psychological criteria have not been well developed and tested, least of all for ready application in a clinical setting (Davis 1986). Sheiham (1973) stated that:

"It is a reasonable aim to define (orthodontic) need as a sociodental indicator which incorporates the clinical, the attitudinal, and the functional status of the individual, as well as the required social and psychological measures".

This theme is further explored (Locker 1988) in the statement that:

"Exploring the link between clinical conditions and their personal and social outcomes promotes a more complex appreciation of oral health and provides
possible opportunities to minimise their consequences".

Locker further states that the "measurement of the impact of dental and oral conditions will broaden our understanding of oral health by adding a subjective perspective to objective clinical measurements". (Locker 1988).

A number of authors (Cohen and Jago 1976, Nikias et al 1979, Reisine 1985) have all noted that there is a lack of systematic data relevant to the social and psychological impact of malocclusion and facial deformities both on individuals and society.

This was reinforced (Cohen and Jago 1976) in a statement that:
"If we take seriously the idea that oral health is a social concept and that dentistry performs what is essentially a social function then we have to develop measures that reflect the true social impact of oral problems."

In a recent article (Locker 1988) this theme of measurement and evaluation of the social effects of malocclusion on an individual was further developed. Three main reasons were proposed in advocating these measurements. They can be summarised as:

1. Such measurements were essential to a full scientific understanding of the scope of the oral health problem with regard to the effect of malocclusion on society.

2. Such information aided rational decision making with regard to the allocation of health care resources.
3. Collection of such data aids in the evaluation of dental health services generally.

All these factors are summarised in an editorial in the Australian Dental Journal (1989) where it was stated that:

"While there are reasonably satisfactory methods for the assessment of occlusal traits we should determine the influence of psycho-social factors on the assessment of the need for orthodontic treatment.

In particular, attempts should be made to determine the characteristics which make it possible to differentiate those people who need and want orthodontic treatment from those who need it but don't want it and those who want it but don't need it."

In conclusion, this same editorial further states that:

"The evaluation of the interaction between these factors may take some time but it is the sort of research that should be encouraged because it is socially relevant and highly desirable from a public health point of view."

This thesis aimed to research this very area of interest.

That is, it aimed to research the interaction between the objective assessment of a subject's occlusion using an occlusal index, and that same subject's self-perception of his or her dental appearance and the strength of the desire for orthodontic treatment (as delivered through the State Orthodontic Service, Tamworth).

Accordingly, a questionnaire was developed which aimed to assess a number of subjective elements thought to be relevant to a person's self-
perception of their dental appearance.
This information was then compared to data gathered by the assessment
of these same subjects using the Dental Aesthetic Index.

A total of 321 children (aged 10 years, 11 years, and 12 years of age )in
the New England area of New South Wales ( the area serviced by the Tamworth State Orthodontic Clinic ) were examined in the course of this thesis study.
CHAPTER TWO

THE NEED and DEMAND FOR ORTHODONTIC TREATMENT

Dentofacial Aesthetics.
Complex social forces shape a society's concepts of dentofacial aesthetics. A wide spectrum of dental, oral, and facial variations and abnormalities exists ranging from minor deviations of the teeth to major developmental clefts. Between these two extremes is a continuum of abnormalities that vary in severity, with these deviations having been shown to have potential aesthetic, emotional, behavioural, and social impact on the affected person.

Although we still use the reactions of others to a person's face and dentition as the most valid criterion for judging dentofacial aesthetics (McGregor 1970), Man's reaction to facial deformity has not been uniform. As McGregor has shown, there is often a paradoxically greater response to mild facial deformities than there is to more severe handicaps. This is thought to be:
1. Because a severe handicap can evoke sympathy and compassion, whereas a more mild deformity may be more a cause of amusement.
2. Because those subjects with defects judged to be severe often seemed to have made a better adjustment "perhaps because the response of others was more predictable" (McGregor 1970).

People who are judged to be different in our society are often stigmatised. A person's emotional health may be severely compromised if their 'abnormality' causes others to react negatively towards them, resulting in a person being treated differently by their peers because of
the perceived abnormality. Therefore, a dentofacial deformity that results in social stigmatisation may be regarded as a handicap possibly resulting in psychosocial disadvantage to, or even crippling of, an individual. For example, Helm et al (1985) showed that teasing occurred seven times more often towards children who had an obvious malocclusion compared to those who did not have an obvious dentofacial deformity. This study also showed that every subject who had an overjet greater than 9mm recalled being teased, and that this teasing led to them having lowered self esteem (Helm et al 1985).

Similarly, Shaw, Addy and Ray (1980 ), in a review of teasing among school-age children, wrote that "social prejudices or stereotyped response with regard to an individual's appearance are now seen to apply, often at the subconscious level, in many facets of social interaction".

A handicapped person can be defined (McGregor 1970) as one, who "because of a physical or mental disability, is at a disadvantage in performing one or more major life activities". A handicapping orthodontic condition can be described as one which is a clinically obvious physical abnormality of tooth and or jaw relationships which results in disability characterized by physical, emotional, and social dysfunction (Davis 1980, p61). The measure of a person's degree of handicap is the extent to which the disability affects him or her. A severe disability would therefore be expected to cause a severe handicap. McGregor (1970) has described different degrees of dentofacial handicap.
Degree 1: Slight  A mild deviation, may distress individuals but does not attract attention.

Degree 2: Moderate  Noticeable, some remarks, but usually no violent reaction from other people.

Degree 3: Marked  Definitely noticeable, likely to evoke strong reactions from others.

Degree 4: Gross  Shocking and repelling to others, evokes violent reaction from others.

This conceptual model, expressed as a flow diagram, was developed by the World Health Organization (1980) and adapted by Locker (1988), and shows the theoretical progression of an impairment to a handicap. Orthodontic treatment can be effective at relieving a subject's handicap at different stages of the progression.

![Diagram](image)

Figure 2.1 General conceptual model of the stages of progression of a disease to a handicap (Locker 1988).
Locker (1988) comments that a disease or a disability can have a negative effect "on marriage and family formation, employment prospects, income, self-image, self-esteem, loneliness and social isolation". A malocclusion or any type of dento-facial deformity can cause loss of opportunity for an individual, with resulting material and social deprivation and dissatisfaction.

**What is a Malocclusion?**

To date, investigators of the prevalence of malocclusion have had to make their own definition to distinguish between the normal and the abnormal. A World Health Organisation Expert Committee on Dental Health (1962) defined a handicapping dentofacial anomaly as one which causes disfigurement, or which impedes function.

Salzmann (1967) defined "a handicapping malocclusion and handicapping dentofacial deformity as conditions which constitute a hazard to the maintenance of oral health, and interfere with the well-being of the child by adversely affecting dentofacial aesthetics, mandibular function or speech."

Neuman (1965) wrote that one should regard as malocclusions only those (dentitions) which can justifiably be regarded as disturbing and/or detrimental to the individual concerned.

Gardiner (1956) defined malocclusion as any departure from normal occlusion which is severe enough to warrant orthodontic treatment. Grainger (1967) defined malocclusion as "any disharmonious variation from the accepted or theoretical normal occlusion of the teeth." Ideal occlusion as defined by Angle (1899) was taken by Grainger to be normal and this provided a point from which variation was measured. He stated that the lack of complete harmonious conformity to normal does not necessarily constitute a malocclusion; the degree of tolerated disharmony needs to be
carefully determined for a specific population. It is obvious that investigators have difficulty in agreeing on the exact definition of a malocclusion, and there seems little possibility that they ever will. An author's definition of malocclusion needs to be understood before any study of the prevalence of malocclusion can be interpreted.

**Estimates of the incidence of dentofacial abnormality.**

Assessment and knowledge of the prevalence and severity of malocclusion in the community plays an important role in planning and providing future treatment resources.

Assessment of the prevalence of malocclusion varies widely among different countries and even between different communities within countries, in this author's view possibly due to the different definitions of malocclusion that are used, and sometimes because of racial differences.

Baldwin (1980) comments that orthodontists generally tend to think in terms of the 'ideal' rather than a 'norm' hence the extremely high prevalence figures of malocclusion that are reported in most epidemiological studies (Sheiham et al 1982).

As an example, on the basis of a sample of some 7400 children 6 to 11 years of age in the United States some 75% of children have some degree of dental occlusal disharmony (National Centre for Health Statistics of the US Public Health Service, 1965). In this U.S. study, 37% of children were judged to have handicapping malocclusion for which treatment was highly desirable. In this same study, 17% of the children had significant protrusion of maxillary incisors, and 25% had improper molar
relationships. Of the total sample, 5% of children were judged to have such severely handicapping malocclusion that treatment was considered mandatory.

In a study in Great Britain, Tulley (1970) estimated conservatively that 50% of children needed some form of orthodontic treatment. In contrast, among Australian Aborigines the prevalence of malocclusion is usually low, thought, among other reasons, to be due to the presence of a generally broad arch form (Begg 1965).

Freer and Olive (1976) reviewed malocclusion surveys and the perceived incidence of malocclusion derived by different authors. Haynes (1973) in a survey of 1185 children, indicated that in his view 75% needed treatment of some type, with 25% of the entire sample needing extraction therapy. Bowden and Davies (1975) in a survey of 183 children, indicated that 65% needed orthodontic treatment. In 1974 Ingervall and Hedegard surveyed 301 Swedish conscripts and felt that 60% required orthodontic treatment both for functional and aesthetic considerations. Helm et al (1975) indicated that 50% of 293 surveyed children required orthodontic treatment.

The incidence of malocclusion is generally high and treatment resources are usually limited. It should be remembered, however, that in many epidemiological surveys orthodontists often judge an individual's occlusion against an ideal criterion, an approach which is not necessarily in agreement with that subject's self-perception of their occlusion. However, even though one could wish to treat all children with dentofacial anomalies, regardless of their definition, due to the shortage of resources efforts are usually necessarily restricted to treating those children with
dentofacial anomalies that are judged to be sufficiently handicapping. The question of an individual's need for orthodontic treatment therefore should be considered.

**NEED**

The word 'need' is sometimes used ambiguously in discussions of public health policy (Culyer 1976, p13). It is necessary to have a clear understanding of what one means by 'need' before someone's 'need for orthodontic treatment' can be discussed.

The dictionary definition of 'need is:

1. "a requirement".
   (Macquarie Dictionary 1981) or

2. "to be in want of".
   (Collins English Dictionary 1980).

The concept of orthodontic need may vary depending on whether one is seeking orthodontic treatment or delivering treatment. In the context of health care generally, when discussing 'need': "it is difficult to tell, when someone says that 'society needs....' whether he means that he needs it, whether he means that society ought to get it in his opinion, whether a majority of the members of society want it, or all of them want it. Nor is it clear whether it is 'needed' regardless of the cost to society (Culyer 1976, p13). People's view about what others need depends upon "a whole variety of factors, deriving from the prevailing culture and social philosophy of a society" (Culyer 1976,p13).
(Matthews 1971 ) says that: "A need for medical care exists when an individual has an illness or disability for which there is an effective and acceptable treatment or cure".

Mooney argues (1986, p75) that in much of the debate about 'need' the simple notion of the need for health care being a 'derived' need- that is , derived from the need for health tends to be lost sight of. This point of view is further discussed by Culyer (1976, p 12).

"It would seem sensible to regard the need for health care services as ultimately related to a need for health per se, since it seems not realistic to suppose that health services are best viewed as instrumental in the promotion of better health".

The one thing that each of the definitions have in common is that "the need spoken about is a need for a service." (Culyer 1976, p 14). If we think someone needs 'some ' service, we are expressing the view that something should be done to change his or her health status (Culyer 1976, p 15).

From the patients point of view, the demand for health care is the result of a more fundamental demand for health itself. (Drummond and Mooney 1983, p 10). Demand assumes that the best people to decide on the values to be attached to various goods and commodities are normally those who will benefit from them. Problems, however, arise when consumers are not very knowledgeable about the relevent commodities, e.g. with health care. (Mooney 1986, p 11)

In any discussion about the orthodontic needs of patients eligible for treatment by the State Orthodontic Service of N.S.W., what has to be recognized is that not all perceived need can be met. Therefore there has be a ranking of needs in the sense that we would prefer that one need
would be met over another, or that one person's needs are seen as more pressing than another person's. Thus, we must trade-off one need against another when resources are limited. "We are forced to rank needs, to assess and to reassess priorities as resource availability changes" (Culyer 1976, p 16).

This idea is further expressed (Sax 1990, p 3): "Because resources are not unlimited, priorities have to be determined and choices made and, wherever resources are to be allocated for the benefit of some people and not others, the matters to be taken into account include the costs and benefits of available options and consideration of associated ethical issues."

It is ethically legitimate do to this type of trading off. It is important that the morality of recognising that need is not absolute and cannot be met in full is accepted. (Culyer 1976, p 16, Mooney 1986, p 76).

Almost always, no matter how need is defined, assessment of need embraces the idea of some third party being involved in the evaluation of that need. The question as to who is the third party is of pressing relevance. This conception of need being determined by a third party has implications. The first of these raises the question as to which third party should have their judgement legitimised in the process of this evaluation. The second implication is that if need is subject to definition by a third party, there must be some way of measuring this need, that ethically should be acceptable to society at large. The moral dilemmas inherent in deciding who gets what are seldom made explicit enough for public participation in priority setting to be adequately informed (Sax 1990). Williams (1988) has pointed out that priority setting now requires a range of efficient and effective methods that are open to society.
The important ethical issue of a third party evaluating a person's priority of need is that the patient should be kept fully informed throughout the evaluation process and, if the clinical decision is to withhold or delay the procedure, the patient must be informed of the opportunities foregone. All the circumstances surrounding the decision should be disclosed. It is unethical to suppress information concerning social policy which inhibits access to medical care that could be beneficial (Sax 1990, p144).

The factors determining both health status and utilisation of health services are, together, to be seen as determining the demand for health itself. There is the requirement of being able to devise a means for comparing need individually and with a group. It can be seen that societies' concept of need is relative, and the urgency with which any need ought to be met is highly conditional.

Health Status Indices
A health status index is a means of transferring the emphasis in decision-making on health care policy from the plane of political judgement to the plane of scientific evaluation, but this presupposes the arguments underlying the construction of malocclusion indices of severity are substantially technical rather than moral (Pole 1973).

If a health status measure is to be able to measure need in some way it should satisfy a number of characteristics:
1. it should be reliable and reproducible by different persons;
2. it should be valid in the sense that it should measure what it purports to measure;
3. it should be capable of being related to some of the variables over which the researcher, practitioner, administrator etc has some control.
(Culyer 1976, p33).
The cost-benefit approach, essentially the weighing up of costs - opportunity costs - and benefits, offers the most comprehensive method of coping with the problems raised in devising and using social indicators and measuring and using the concept of 'need'.

CONCLUSION.
Need is not, or never was, purely a technical matter, and it requires the exercising of moral judgements in defining what needs are and which of them are more important than others. Analysis suggests that definition of dentofacial deformity or the establishment of social trade-offs is not mainly a matter for health professionals. Culyer (1980, p 67) presents the concept of need in its instrumental context where he argues that a service is needed if it is a necessary instrument for the accomplishment of a particular outcome e.g a better quality of life.
The concept of 'demand' retains the basic feature of the individual's own assessment of benefits. The concept of 'need', provided it encompasses some assessment of effectiveness, the potential for considering alternative ways of meeting need and to differing extents, and acceptance of resource restraints, can also form the basis for resource allocation. It will normally be best for both need and demand to be taken into account when a particular operation of a health service is being examined; neither demand nor need by itself is likely to provide a sufficient basis for decision-making.
The concept of need thus developed is (Culyer 1976, p 30):
1. an assessment by a third party or third parties of
2. an individual's, group's or population's health status such that
3. it ought to be increased.

When a third party is involved in assessing need and demand for a health service it is important to remember that "Whatever the financing mechanism, the question of justice and equity in health care seems important. Whatever else people dispute in health-service policy, there is general agreement that fairness should be a part of health care."

( Mooney 1986, p 107)
CHAPTER 3

BODY IMAGE AND THE MOTIVATION FOR ORTHODONTIC TREATMENT

Standards for the social acceptability of one's physical appearance are established in society at large, and there are strong expectations to conform to these expected physical norms. Such norms are culturally defined, and can also change from time to time (Jenny 1980).

Studies have shown (Davis 1980, p67, Jenny et al 1980) that each individual possesses an attitude towards his or her own body which is based on the personal accumulated experiences and feelings they have developed towards it. These experiences are generally derived from the reactions of other people to that individual's appearance. The cultural emphasis on norms for physical attractiveness, and the negative appraisal received from others for departure from those norms can lower an individual's self-esteem or feeling of self-worth.

It should hardly be surprising then that much of the great public interest in oral health and the subsequent interest in orthodontics seems to issue more from a concern with cultural ideals of body image than from any other reason. Social factors are therefore significantly implicated in the very processes by which orthodontic problems come to be defined for a patient and seen as socially significant (Shaw, Addy, Ray 1980).

These social realities influence the entire process of decision making for an orthodontic patient, from their initial self-identification and assessment of what they perceive to be their dento-facial handicap.
through to their contact with the orthodontist and even to the course of their treatment itself.

Features of the mouth and face are generally acknowledged as being critical in defining a person's public persona and their essential normality in social interaction with others (Davis 1980, p64), and acceptance of this close relationship underlines the extent to which the normality of the dental and facial appearance of a person is quite central in defining the social normality of the person.

The aesthetic implications of malocclusion should therefore not be underestimated, for they provide perhaps the most important consumer motive for seeking treatment, as orthodontic treatment has been shown to enhance the self-concept of patients who complete treatment and to help them to be more accepting of themselves (Davis 1980, p74). Baldwin and Barnes (1966) found that reality factors, such as dentofacial deformities, accounted for the primary motive in fewer than 5% of the families where a patient sought orthodontic treatment.

There is usually a lack of agreement between investigators in attempts to assess orthodontic handicaps as the clinical definition of need as determined by an orthodontist rarely coincides with consumer definitions of need for treatment. The disease analogy itself is flawed in that the standard by which orthodontic need is judged is an abnormal condition, for, as discussed, most treatment is carried out for cosmetic and not health reasons, and "dental appearance is assumed to be a significant aspect of overall physical appearance" (Jenny et al 1980). Clinical intervention should be judged not just in terms of conventional biophysical measures of normal dentition and appearance, but rather in
terms of social and psychological criteria such as self-image, acceptance by others, social participation, self-confidence, and so forth.

Davis (1980, p36) defined deviant conditions as those which are socially unacceptable and which attract both formal and informal sanctions from other people. He wrote that standards of acceptability vary by time, place, and between social groups. Davis (1980, p41) furthered this point of view in writing that some aspects of the oral condition, particularly malocclusions, can evoke strong reactions from other people, and in consequence can shape the behavior and self-image of the person concerned, a process he termed 'labelling behavior'. In discussing the concept of 'stigma', Davis (1980, p42) wrote that informal labelling can have an effect on a persons social identity. e.g. a child with a disfigured face may be regarded by (for example, by their teachers) as being mentally inferior to other children. These reduced self-expectations may result in a child becoming an underachiever, giving a self-fulfilling prophecy in which the expectations of others shaped a person's self-image and behavior. Research by Shaw (1980b) indicated evidence that some children with severe malocclusions can suffer resulting emotional handicap and subsequent decreased self-esteem. Dentofacial deformities can therefore invoke reactions and evaluations that are socially and to a degree, morally charged.

In the main, those who seek orthodontic treatment usually have the more severe types of malocclusion as defined by clinical measures and self-perception (Albino et al 1981), with self-perception of body image being by far the most dominant reason for the motivation of a person towards having orthodontic treatment ( Schroeder 1972, Jenny and
Proshek 1986). The overall social context in which dento-facial deformities are defined and in which orthodontics is practised need to be understood in any discussion concerning motivation for orthodontic treatment.

The motivational factors behind a patient wishing to have orthodontic treatment can be as varied as the personality of the patient themself, for in orthodontics, people define their own problem, they do not just experience them. Schroeder (1972) reported that psycho-social factors play a major role in an individual's motivation for orthodontic treatment, and increasing evidence from social psychology studies show that unacceptable dental (and this author assumes skeletal) appearance when compared with societal norms may effect the individual's socialisation process (Jenny and Proshek 1986). Unacceptable dental appearance has been shown (Schroeder 1972) to have a number of effects:

1. It can stigmatise the individual socially.
2. It can impede an individual's career chances.
3. It can affect an individual's peer group acceptance.
4. It can encourage negative stereotyping of an individual.
5. It can adversely affect an individual's self-concept.

Zola (MacGregor 1970) showed that if an individual perceives that a problem "causes interference with their vocational or physical activity" or if the individual experienced social pressure in some way due to their perceived problem, they were highly likely to seek professional help or advice in an effort to find a solution to the problem. Moyers and Jay (1970) stated the most common motivating factor that making a person aware of the availability and need of orthodontic
treatment was a recommendation by a general dental or medical practitioner, or the patient's desire to correct a dentofacial disfigurement.

They stated that the three main motivating factors were:
1. An individual's awareness (of the perceived problem).
2. An individual's knowledge of what could be done (to correct the problem).
3. An individual's acceptance of the corrective service required to fix the problem.

Jenny and Proshek (1986) proposed the hypothesis that for prestigious occupations, good dental aesthetics is important, and showed that the importance of dental appearance is highly related to the visibility of the person. Tulley (1970) reported that youngsters seeking orthodontic treatment expected that straighter teeth would increase their popularity, improve their speech, their looks, lead to less teasing and lead them to have more friends. It was found that the degree of parental interest was the main factor in seeking treatment. These studies have their findings consistently supported through the orthodontic literature, in that functional problems are the motivating factor behind a minority of patients seeking treatment.

Status seeking has been shown as a motive present in a substantial proportion of families seeking orthodontic treatment, with some studies showing that the parents (particularly the mother), rather than the child, were the primary motive behind orthodontic treatment for the child (Darsey and Karabite 1977). This was thought to be because the mother believed treatment would lead to the child having an improved
appearance, which would lead in turn to the child having better social and occupational opportunities (Darsey and Karabite 1977). The mother played an important role in referral and treatment supervision. When the children lost interest, treatment was interrupted, and this was independent of both the stage and the degree of improvement reached.

Herren et al (1965) pointed out that from a psychological point of view orthodontic patients displayed a great variability in terms of their different age groups and different stages of development, social disparities, and diverse types of character, temperament, and intelligence. Herren et al (1965) felt that the common thread between orthodontic patients was that they perceived a problem and were willing to undergo the clinical steps necessary to fix the problem, and therefore were willing to make a conscious decision to adopt a particular health behaviour. Geboy (1985) defined health behaviours as those activities an individual engages in to prevent or cure health problems, with the particular behaviour adopted being a function of the interaction of a variety of factors including the individual's belief and attitudes, their psychomotor skills, environmental enabling factors, and the individual's self-management and self-control capability.

Moss (1981) discussed wastage, or the number of patients who failed to complete a course of orthodontic treatment. He showed that patients treated between 1960 and 1970 within the National Health Service of England and Wales showed a 16% to 18% drop-out rate before treatment was completed. Similarly, in a study of cases treated by Andresen appliances at the University College, (London) Cohen (1980) found that 23% of patients failed to complete treatment due to treatment due to lack of co-operation or non-attendance. Moss's impression was that
patient co-operation for orthodontic treatment was poorer in hospital and health service practice than in private practice, and felt that the direct payment of fees appeared to spur patients to greater interest in their treatment (Moss 1981). Discontinuation of treatment, once commenced, can be regarded as highly undesirable, as it results in a waste of clinical effort and resources, and possibly may deprive other patients, suitably motivated and prepared to fully co-operate, from receiving treatment.

It seems highly desirable to minimise this wastage of resource, particularly in the area of public health orthodontics where the demand for treatment exceeds the capacity to deliver the care. Careful analysis and understanding of the motivation behind any particular patient's desire for orthodontic treatment seems to be necessary to minimise this wastage, to maximise the chance of a successful outcome for any course of orthodontic treatment, and to help an individual to a self-satisfied state of acceptance of their own body image.
CHAPTER FOUR

MALOCCLUSION INDICES

INTRODUCTION
A number of malocclusion indices have been developed by different authors, each with the intention of being able to assess and compare malocclusions within a given population in an objective manner as is possible. Although studies suggest that it will be very difficult to develop an index which records and scores all the clinical conditions which contribute to malocclusion (Turner 1990), the search continues for an occlusal index which can be utilised simply, acceptably, reliably, and validly by both orthodontists, dentists, auxiliary dental personnel, and consumers of orthodontic care.

The requirements for all malocclusion indices have been summarised in the World Health Organisation (1966) report on international methodology for epidemiological studies of oral diseases. The requirements are:
1. A dental index should be reliable: i.e. have a high level of intra-examiner and inter-examiner reproducibility
2. A malocclusion index should be valid, i.e. measuring what it is intended to measure.
3. A malocclusion index should be valid during time i.e. the index should consider the normal development of malocclusion and allow for growth and development (Turner 1990).

Health Status Measures.
There are a variety of purposes for which health status measures may be used. These are listed by Culyer (1976, p 32) as:
1. for research purposes
2. in clinical practice e.g. to monitor patient states.
3. in clinical rationing eg. to select patients by degree of priority:
4. in health service planning
5. in international comparisons.

It should be recognised that health measurement itself is difficult for three reasons (Mooney 1986, p34). Firstly, health itself is a value-laden concept. Secondly, the concept of health is multi-dimensional, including factors related to both an individual and society. Thirdly, it is not enough to measure health ordinally, we need cardinal measurement. Therefore it should be recognised that using any health status measure, such as a malocclusion index, to measure some aspect of health, such as malocclusion, is fraught with inherent inaccuracies. A main aim of using any malocclusion index should be to minimise these inaccuracies.

It would be useful to have a generally agreed-to definition of orthodontic conditions that are seriously handicapping and to be able to recommend objective clinical criteria by which they can be assessed. At present no malocclusion index is universally accepted as meeting this requirement. Variations in terminology, methodology, and aesthetic dental concepts are cited as the major reasons for the present lack of a universally acceptable index of occlusion (Summers 1971; Freer 1989). There can often be a lack of agreement between investigators in assessing orthodontic handicap.

Jago (1974) comprehensively listed the many malocclusion indices that have been developed by different investigators, with the more prominent of these indices now to be reviewed in some detail.
Index of Handicapping LabioLingual Deviations (HLD)

Draker (1960) produced an Index of Handicapping Labio-Lingual Deviations (H.LD.). This index aimed to measure the degree of such factors as overjet, overbite, mandibular protrusion, openbite, labio-lingual spread, and also took into consideration such factors as traumatic deviations, cleft palate and ectopic eruption. The index made use of a weighted scale determined by statistical calculations. One main aim of this index was to determine the eligibility of orthodontic patients for public orthodontic care (under the provision of New York State legislation covering care for crippled children), but there was disagreement as to its effectiveness in achieving this aim. As with other malocclusion indices that followed, it was limited to physical occlusal measurements and did not include a functional occlusal assessment or evaluation of the psychological implications of a dentofacial deformity (Turner 1990).

The Handicapping Malocclusion Assessment (HMA)

The Handicapping Malocclusion Assessment Record together with a Supplementary Oral Assessment Record for Dentofacial Deviations was developed in 1968 by the American Association of Orthodontists under the chairmanship of J.A. Salzmann. The teeth in malocclusion in the index are assessed according to the criteria and the weights or point values assigned to them. The relative point values, according to Salzmann (1968) were based on clinical orthodontic experience, by judging the effect of various types of malocclusion on dental health, function, and aesthetics. The point values of the Handicapping Malocclusion Assessment Record forms were tested by orthodontists from various parts of the United States. Salzmann states (Salzmann 1968) that there was an extremely high correlation with the subjective clinical ratings of severity of malocclusion.
Teeth were considered to be maloccluded when some were missing, crowded, rotated, or spaced. Occlusal features include overjet, overbite, crossbite and openbite. Anteroposterior deviations of one cusp or more were scored. The teeth were scored as follows:
2 points for maxillary incisors
1 point for all other teeth
In addition, 8 points was scored if any of the following features were seen -:
1. lower lip under maxillary incisors
2. facial or oral clefts
3. facial asymmetry
4. functional limitations
5. occlusal interferences or speech impairment
   A number of these factors in this author's view are not easy to judge consistently.

Salzmann (1968) felt there was use for the Handicapping Malocclusion Assessment Record in establishing potential orthodontic case load. A random sample of the frequency and the range of severity of malocclusion possibly could be obtained in a child population in the community. A cut off point could then be set at an assessment score that would permit treatment of patients by personnel and funds available.

The Eastman Esthetic Index (EEI)
A malocclusion index designed to attempt to measure the aesthetic factor objectively was the Eastman Esthetic Index, developed by Howitt, Stricker, and Henderson (1967). It was developed in the late 1960's in response to the growing awareness of the need for considerations other than purely physical measurements on stone models to determine need and
described an objective index to measure aesthetic handicap. The Eastman
Aesthetic Index measured overjet, overbite, openbite, the number of teeth
crowded out of the arch, the number of rotated teeth, the severity of the
rotations, mandibular incisor alignment, diastemas and fractures of
anterior incisor teeth. Weighting of various features was deemed
necessary as several of the factors could be present without detraction
from the appearance of the subject.

One hundred and twenty high school children were assessed and the
results were correlated with a questionnaire filled out by each of the
subjects. The questionnaire dealt with the subjective evaluation of their
own mouth and teeth. The four questions were (Howitt et al 1967):

1. How satisfied are you with the general appearance of your teeth? (circle one number)
   1. Very satisfied.
   3. Mildly unsatisfied.
   4. Very unsatisfied.

2. How satisfied are you with the appearance of your smile? (circle one number)
   1. Very satisfied.
   3. Mildly unsatisfied.
   4. Very unsatisfied.

3. Compared to other friends of your age, how do you think your teeth look?(circle one
   number)
   1. Among the nicest.
   2. Better than average.
   4. Among the worst.
4. How would you consider your teeth as compared to your entire face? (circle one number)
   1. One of the nicest features of your face.
   2. Better than average feature of your face.
   3. Below average feature of your face.
   4. One of the poorest features of your face.

There was significant correlation between the questionnaire and the index and the authors stated that this confirmed the validity of the index. As assessment of dental aesthetics is acknowledged to be dependent on ethnic, social, and psychological factors as well as on occlusal considerations, an assessment of occlusal anomalies alone will not adequately score aesthetic dento-facial handicap. The Eastman Esthetic index was developed to try to measure an aesthetic handicap. The developers of the E.E.I used most occlusal traits previously included in malocclusion indices. Traits of the most visible teeth which they believed would affect aesthetic judgements were arbitrarily weighted. The apparent correlation between the EEI and the measured self-perception of dental aesthetics was not strong since one-third of their adult subjects not satisfied with their teeth had a reasonably aesthetic dentition on the basis of the EEI scores (Katz 1978).

The Orthodontic Treatment Priority Index, (TPI)
Grainger (1967) described the development and use of a method of assessing the severity of the most common types of malocclusion. He aimed to provide a means of ranking individuals, according to their severity of malocclusion, their degree of handicap, or their assessed priority for treatment, and called this index The Treatment Priority Index.
The Treatment Priority Index was developed to attempt to determine whether orthodontic treatment reduced the severity of malocclusion below the level of public health significance. It was thereafter recognized
both for epidemiological surveys of malocclusion and as a screening tool in public health programs (Ghafari et al 1989). Its scoring involved the assessment of the seven dental parameters of: overbite, positive overjet, negative overjet, anterior openbite, posterior crossbite, rotation, and crowding. On the basis of multiple regression analysis these seven parameters were weighted according to the first permanent molar relationship (Ghafari et al 1989). A constant, corresponding to the molar occlusion, was added, giving a TPI score of between 0 and 10 (Grainger 1989).

The development of the TPI was based on the orthodontic models or the clinical examinations of 375 12 year old children from 3 Ontario communities who had no history of previous orthodontic treatment. (Ghafari et al 1989; Turner 1990).

The Occlusal Index (OI)

Summers (1971) proposed an occlusal index that scored nine occlusal characteristics. Dental age, molar relation overbite, overjet, posterior crossbite, posterior openbite, tooth displacement, midline relations and missing permanent teeth were scored. Also suggested was a subjective classification to interpret the scores. The index was based on the Burlington-Grainger Severity Estimate and Treatment Priority Index, and was scored in syndromes designed after those of Grainger.

This index was directed at communities with complete dentitions. Validity was reduced when the index was used in population groups where a great number of dentitions were mutilated. McEwen et al (1964) showed that 51.8% of 13 year old Dundee schoolchildren had lost at least one permanent molar, and commented that the index could not be used universally as regard must be given to the type of community under survey.
The Dental Aesthetic Index.

The Dental Aesthetic Index (Cons et al 1986) is a recently developed occlusal index that involves the assessment of ten occlusal measurements. Its design and calculation method aim to reflect the social acceptability of a patient's dental appearance. It has been shown to be a valid index in surveys that vary in location and population background. The Dental Aesthetic Index, the occlusal index used in the field survey of this thesis, is discussed in detail in Chapter Five.

As most orthodontic treatment is carried out largely for cosmetic and not health reasons (Davis 1980, p51), there is a strong subjective element involved in self-identification of malocclusion and therefore the clinical definition of need rarely coincides with consumer definitions. A number of studies have been undertaken in which the validity and reliability of malocclusion indices have been examined.

Comparative Studies of Malocclusion Indices.

Popovich and Thompson (1971) compared the results of an Orthodontic Treatment Priority Index score with the subjective appraisal of subjects occlusions by an orthodontist. The Orthodontic Treatment Priority Index was designed to objectively assess the prevalence of malocclusion, the degree of handicap and the need for orthodontic treatment. When the results from 1420 dental casts were compared, some differences were noted between the computed index scores and the orthodontist's subjective appraisal. These differences were marked in the middle malocclusion severity group for determining the number of patients that could benefit from orthodontic treatment (Popovich and Thompson 1971).
Grewe and Hagan undertook a study in 1972 the objectives of which were to estimate the precision or chance error and bias or systematic error of the Handicapping Malocclusion Assessment Record, the Occlusal Index, and The Treatment Priority Index. The authors felt that before any of the indexes could be used for the purpose of assessing the orthodontic treatment need of an individual, "the precision or chance error and the bias or systematic error for the index utilized should be known" (Grewe and Hagan 1972).

Subjective evaluations were made of orthodontic study casts by four examiners, all members of the orthodontic faculty of the University of Iowa College of Dentistry.

The study sample of 130 plaster casts were from the pretreatment records of patients ranging in age from 11 to 15 years who had sought treatment at the University of Iowa College of Dentistry during the years 1962-1968. The casts were grouped and ranked in order of treatment need (assuming there were limited funds allocated for treatment). Casts were excluded because of the following reasons:
- extraction of a permanent tooth
- questionable articulation of upper and lower casts
- broken or chipped teeth which would make measurements or observations impossible
- presence of deciduous teeth.

Intra-examiner differences of overjet measurements and tooth displacements were examined by Grewe and Hagan (1972) comparing the HMAR, OI, and TPI. With the OI and TPI, the correlations were found to be higher for overjet than for tooth displacement (Grewe/Hagan 1972).
The following were estimated for each index:

:- intraexaminer variability of the objective examiners.
:- intra-index variability
:- inter-index variability
:- inter-examiner variability of the subjective examiners.
:- and the relationships that exist between a sample of malocclusions ranked by each of the 3 indices according to severity and the same sample ranked by a group of subjective examiners.

Grewe and Hagan (1972) concluded that the three indexes showed a reasonable overall consistency in their assessment, but there were a number of casts assessed as having a different treatment priority both by different examiners and different indices. Grewe and Hagan (1972) concluded that "Perhaps psychologic or skeletal parameters should exert more influence in establishing orthodontic treatment priority."

Grewe and Hagan stated that an index should be precise and unbiased, and the scores obtained must be reproducible between and within examiners. They also concluded that large samples of patients or dental casts with small differences between the malocclusion index scores give less spread of scores than do smaller sample groups (Grewe/Hagan 1972).

Turner (1983) undertook a study of the feasibility and validity of orthodontic screening of children in their tenth year using the Treatment Priority Index.

This study was divided into two parts
1. The examiner standardization exercises.
2. The main study, which involved a sample size of 362 children (181 boys/181 girls).

The mean time taken to examine each child was 83 seconds, with a range
of 42-174 seconds, and "in order to simulate the conditions under which school inspections are conducted, all the children were examined in natural light using a plain mirror." (Turner 1983).

Turner (1983) expressed some criticisms of the TPI from this study. He found that the TPI was not identifying the dental crowding that had been transferred to the buccal segments by early loss of deciduous canines. In addition, a study by Popovich and Thompson (1971) found that the main reason for its misclassification of subjects at the age of 9 years was that the TPI was not rating displaced or rotated teeth as highly as would the orthodontist, a statement supported by Turner.

Turner (1983) concluded overall that the TPI may be able to provide useful screening information of treatment needs of children aged 10 years if:
1. The weights of the clinical entities which, in his view, were reducing the level of the validity of the TPI were identified.
2. The problem of scoring tooth displacements consistently was taken into consideration when training personnel to use the TPI.

In an article in 1988 Locker discussed the screening and assessment of malocclusions and dentofacial deformities. Locker noted that data on health status and changes in health status over time had become of greater significance in the planning and evaluation of health care provision.

Locker (1988) expressed the view that sociodental indicators were presently too narrowly defined to capture the multidimensional nature of oral health and the many subtle and psychological effects of oral disorders. At some length Locker (1988) discussed the view that the "behavioural and subjective consequences of dental and oral conditions need to be considered." He defined sociodental indicators as "measures of the extent to which dental and oral disorders disrupt normal role functioning" (Locker
1988).

He further stated his view that measuring health meant that clinical indices needed to be supplemented by some measures of the social and emotional aspects of health, and that a malocclusion index which failed to take these factors into account was too narrowly defined to be of real use in assessing the impact of a dentofacial deformity on an individual.

In a study by Scivier et al (1974) to test the TPI, 2 orthodontists compared their use of the index with 2 separate studies of 100 school children. Each orthodontist re-examined 20 children for reproducibility, and results indicated that the intraexaminer reliability was good. Overjet was measured with a small mm rule, but the accuracy of this method was felt by the examiners to be in doubt and a plastic mm gauge fitted with a sliding metal band marker was utilised in the main studies. This gauge aimed for precise measures.

Scivier et al (1974) agreed with Grainger (1967) that deep overbite was likely to be underestimated in TPI assessments. Grainger (1967) discussed the results of examining children aged 6,9,12,14,and 16 years using the TPI, and found a gradually increasing mean TPI score with the increase of age, but did not compare these with scores with subjective assessments.

The authors found the TPI to be a reliable objective method of assessing the presence and degree of malocclusion (Scivier et al 1974). The TPI was found by the authors to be simple to use after practice. Objectivity was thought by these authors to be a strong point of the index, along with its clear and concise scoring criteria. Scivier et al (1974) also felt that it would be difficult to produce an index with a number of occlusal factors involved and commented that it was
easier to assess occlusal extremes rather than the middle range variations. It was suggested it would be advantageous if one index could measure the desired features of occlusion beside determining the scale of the severity, the need for treatment, the possibility for correction, the demand for treatment, and the availability of services (Scivier et al 1974).

Ghafari aimed to check the "long term predictability of the TPI" (Ghafari 1989), as he felt it had not yet been established. During this study Ghafari stated that he felt assessment of overjet and overbite was difficult with the TPI because various stages of a subject's growth or eruption of their incisors reduced accuracy. He wrote (Ghafari 1989) that although the TPI was helpful in describing the general need for treatment in a given population, epidemiological indexing of malocclusion should not become a means to determine the need of orthodontic treatment in the individual patient.

He concluded that the TPI is a valid epidemiological indicator of malocclusion, but it does not predict the future severity of malocclusion in the permanent dentition. He also concluded in so far as the TPI reflected the effect of treatment, its validity was enhanced (Ghafari 1989).

Turner (1990) reviewed 3 indices for attributes of:

1. reliability
2. validity
3. validity during time.
The indices reviewed were

1. Salzmann's Handicapping Malocclusion Assessment (1968)
2. Summer's Occlusal Index (1971)
3. Grainger's Treatment Priority Index (1967)

Five Community Dental Officers and two orthodontists were involved in the assessment. The TPI score was obtained by 12 clinical items using Graingers (1967) and Turners (1983) criteria. These clinical items included bimolar relationships, maxillary overjet, reverse overjet, overbite, openbite, tooth displacement using Van Kirk and Penell's (1959) method, developmentally missing teeth, unerupted central incisors, peg-shaped incisors, thumb sucking, mandibular displacements, and posterior cross bites (Turner 1990).

Van Kirk and Pennel's (1959) method of assessing tooth displacements involved scoring tooth malpositions according to the number of teeth with minor or major rotations or displacements. A tooth displaced by less than 2mm from the lines of the arch or rotated less than 45 degrees would be denoted as a minor displacement. A tooth assessed as having more than 2mm displacement or 45 degrees rotation would be classified as a major tooth displacement, with major displacements scoring twice that of minor displacements (Turner 1990).

Turner commented that the indices reviewed did not account satisfactorily for serial extractions that may have been carried out and that developmentally missing teeth could not be determined without radiographs and therefore subjective assessments had to be made concerning this factor (Turner 1990).

According to Grewe and Hagan (1972) the Occlusal Index was the most valid (of the 3 indices), but Turner (1990) concluded that "the Occlusal Index is more difficult to use in the field when assessing malocclusion in the mixed dentition".

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The World Health Organization (1966) stressed the need for subjective measures of the perceived health needs and health status of consumers of health care. White (1974) indicated that such indicators of people's problems and complaints should be incorporated in epidemiological surveys. Sheiham et al (1982) concurred with Reisine's (1981) suggestion that disruption in normal social functioning could be used as a basis for measuring impact of dental ill health. Sheiham et al (1982) disagreed with the "commonly held assumption in health care that need can be objectively determined. Health care must and can be defined in other ways."

Summers stated (1971) that "for an index of occlusion to be valid during time, the index score for the occlusal disorder should either remain constant or increase during time."

Summers (1971) felt that by classifying occlusion into a dental age e.g. middle mixed dentition, late mixed dentition and so on, "the differences in chronologic age, sex, and sequence of tooth eruption are corrected." (Summer 1971). However, second permanent molars were not considered in the assessment of dental age in the Occlusal Index, as Summers (1971) felt their eruption time was too variable.

In assessment of mixed dentition tooth displacement was divided into two types depending on the cause:
Type 1: Tooth displacement not associated with space deficiency (i.e deviated 1.5 mm or more, or rotated more than 35 degrees).
Type 2: Tooth displacement associated with space deficiency. This author feels such a division of tooth displacement is rather arbitrary, and requires specialized orthodontic knowledge to be able to make the assessment.
This information is factored into the weighting mechanism of the Occlusal Index with the intention of making the index valid over time (Summers 1971). Summers also proposes estimating the width of unerupted premolars and canines, again, in this author's viewpoint, a somewhat unreliable measurement.

The full scoring form and system required by the Occlusal Index is comprehensive and tends to be complicated. This author feels the Occlusal Index is therefore more for specialist use than general use, and feels that the Occlusal Index is not the first choice for a sizeable survey study or initial screening for orthodontic need.

The Occlusal Index was tested for validity during time, and also tested for intraexaminer reliability by Summers (1971). The Occlusal Index appeared to correlate highly (Rs = 0.920) with the clinical standard, indicating high validity. The Occlusal Index also appears to be valid during time. Intraexaminer reliability was very high (r=0.963) (Summers 1971).

Popovich and Thompson (1971) compared the TPI with the subjective appraisal of an orthodontist, and concluded that the TPI was a useful epidemiological index between ages 3 years to 16 years.

Katz (1978) used 8 orthodontic indices in an attempt to distinguish individuals who were satisfied with their dental appearance from those who were not. His study group comprised 162 students between the ages of 15 to 25 years, all of whom were seeking orthodontic care, and all having had no previous history of orthodontic treatment. He found that all indices were weak in their ability to distinguish a subject's self-perceptions of dental aesthetics. This study, however, seems somewhat flawed, because if 'satisfaction' or 'dissatisfaction' with dental appearance was determined by aesthetics, yet all 162 students were
seeking orthodontic care, there was no control group in this study for comparison.

A clear theme emerging from the published writings concerning the development and testing of malocclusion indices is expressed by Turner (1990) who states "it will be difficult to produce an index which considers all aspects of malocclusion and which can be used consistently by personnel untrained in orthodontics".

With regard to occlusal indices in their possible use as a means of determining treatment priority, Jenny et al (1980) comments that "occlusal conditions must be scaled by an adequate cross-section of the public", and agrees with the view expressed by Helm et al (1985) that

"it is premature to devise indices of malocclusion before the association between various occlusal traits and socio-psychological factors have been established", and argued further that "a child's (or parent's) perceived needs are not the appropriate dimensions on which to base need for publicly funded treatment." (Jenny et al 1980). Moorees et al (1971) concluded that the impact or the effect of malocclusion on the social or psychological well-being of the individual "cannot be measured by, and must be independent of, the methodology used to evaluate the occlusal morphology itself", and that without an index able to measure occlusal morphologies that impact on psychosocial function no predictions can be made regarding the need for orthodontic treatment to prevent psychosocial impairment.

**SUMMARY**

There is obviously a limit to the information that can be obtained from a relatively uninformative malocclusion index regarding the aetiological complexity of malocclusion.

Epidemiological registration of malocclusion, the registration of
quantitative and qualitative inter-relationships of occlusal parameters of malocclusion and the possible determination of occlusal parameters for dental abnormalities appears to hold promise for future studies. The more straightforward malocclusion indices which are suitable for use by dental personnel without specialist orthodontic knowledge may exclude useful information through their very simplicity, but at the same time be quite appropriate for primary orthodontic screenings of large groups.

The Dental Aesthetic Index has been acknowledged as a relatively simple malocclusion Index, and was used in the field survey of this thesis. It is reviewed at length in the next chapter.
CHAPTER FIVE

THE DENTAL AESTHETIC INDEX

This contemporary malocclusion index was published in 1986 (Cons, Jenny and Kohout, 1986) and focuses its attention on the aesthetic aspects of occlusal traits.

The Dental Aesthetic Index (DAI) is an index obtained from a number of objective physical occlusal measurements and is designed specifically by its authors to measure dental aesthetics. It aims to assess the relative social acceptability of dental appearance based upon the public’s perception of dental aesthetics.

The DAI was developed using photographs of occlusal configurations as 'stimuli' representing the wide range of occlusal conditions found in a natural population of 500,00 American adolescents (Cons et al 1986). The developers of the DAI had an archive of models of 1337 students that were collected from a probability sample of high school students, ages 15-18, in upstate New York U.S.A. Two random samples of 100 models sets were drawn, and rated for social acceptability by over 2000 American subjects. A regression equation was developed that scientifically related occlusal trait measurements of the 200 study models to their mean scores for social acceptability.

Mean scores for social acceptability of these stimuli were related by factor analysis and stepwise regression procedures to the occlusal trait measurements that were available for each of the occlusal configurations. The DAI was validated by a statistical procedure known as double cross-
validation (Cons et al 1986).

According to its authors, the DAI provides dental epidemiologists with a research tool to rank a person's dental aesthetics on a scale of societal norms. The DAI was designed for intraoral use without the use of radiographs in clinical assessments of people with permanent dentitions. It should be noted at this stage that some subjects surveyed in this thesis study were in the late mixed dentition stage of development, and this factor is discussed fully in the Discussion section (Chapter Eleven) of this thesis.

The DAI equation calls for the measured components (occlusal traits) to be multiplied by their regression coefficients (rounded to whole numbers). The addition of the products plus a constant (rounded to 13) gives the DAI score.

The regression equation for a DAI score is:

\[
\text{DAI score} = 6(\text{missing visible teeth}) + 1(\text{crowding}) + 1(\text{spacing}) + 3(\text{diastema}) + 1(\text{Largest upper anterior irregularity}) + 1(\text{Largest lower anterior irregularity}) + 2(\text{Anterior maxillary overjet}) + 4(\text{Vertical Anterior Overbite}) + 3(\text{Anteroposterior Molar Relation}) + 13.
\]

After the calculation of an individual's DAI, the score can then be placed on a continuum already established for a large population group to enable comparison.

An early step in the development of the DAI (Cons et al 1986) was the development of a method for measuring public perceptions of the social acceptability of occlusal conditions. The mean scores for social
acceptability of the occlusal configurations that were rated by the public when arrayed from most to least socially acceptable is called the Social Acceptability Scale of Occlusal Conditions (SASOC). It was found (Cons et al 1986) that the use of SASOC "yields close agreement among rankings of occlusal morphologies along the complete spectrum of dental appearance from the very unacceptable to the excellent" when rated by orthodontists and children and adults in Australia, The German Democratic Republic and the United States (Cons et al 1983).

The authors of this index argue that most patients seek orthodontic treatment primarily for aesthetic reasons and less commonly due to functional problems. The underlying concept is that the more a person's appearance deviates from the social norms, the more likely it is that the person will experience social handicaps, and therefore need orthodontic treatment. Thus the greater the DAI score, the greater a person's need for orthodontic treatment.

Its authors claim this index can be used to rank individuals in terms of urgency for public orthodontic programs, and it is also claimed to be useful as a decision-making tool by administrators for any given population. In this sense it may help establish the urgency of treatment need and the general level of malocclusion in a population.

The index is not a diagnostic tool. It is a screening tool, and therefore may be useful in a public orthodontic programme where the demand for treatment is greater than the capacity to deliver the treatment. One aim of the State Orthodontic Service is to treat those patients who are most in need of treatment. When demand for orthodontic treatment exceeds the capacity to supply the treatment (such as with the S.O.S.) the use of an
index such as the DAI may help determine treatment priority. According to
the authors of the DAI the higher a patient's DAI score, the worse should
be their malocclusion.

The DAI has been extensively tested for its validity in Thailand, the
German Democratic Republic, Australia, Canada, and the U.S.A. The index
was shown to have high validity in all these countries (Cons et al 1989).

Each of the occlusal assessments used in using the DAI regression
equation will now be discussed in turn, with the information source being
Cons et al (1986).

0. **Constant** Assessed statistically at being 13.

1. **Missing incisor, canine, and premolar teeth.**
If spaces are closed, the teeth are not counted as missing. If a primary
tooth is still in position and its successor has not yet erupted, the tooth
is not counted as missing. If a missing incisor, canine or premolar tooth is
replaced by a fixed prosthesis that tooth is not counted as missing.
If, for example, the second deciduous molars are mobile in a patient aged ,
say, 11 years, the examiner should assume the expected underlying
premolar is present.
2. **Crowding in the incisal segments.**

Upper and lower incisal segments are examined for crowding.

0 = no crowding
1 = one segment crowded
2 = two segments crowded

![Anterior Segment Crowding Diagram]

3. **Spacing in the incisal segments.**

When measured in the incisal segment spacing is the condition in which the amount of space available between right and left canine teeth exceeds that required to accommodate all four incisors in normal alignment.

0 = no segment spaced
1 = 1 segment spaced
2 = 2 segments spaced

![Anterior Segment Spacing Diagram]
4. Diastema (in mm.)
A midline diastema is defined as the space, in millimeters, between the two permanent maxillary incisors. This measurement can be made at any level between the mesial surfaces of the central incisors and should be recorded to the nearest whole millimeter.

5. Largest anterior irregularity Maxilla (in mm).
Irregularities may be either rotations out of, or displacements from, normal alignment.

Measurement is the same as on the upper arch except that it is made on the lower arch.

MEASURING LARGEST ANTERIOR IRREGULARITY
7. **Anterior maxillary overjet (in mm)**
This is the distance, assessed in a horizontal direction, between the incisal edge of the upper central incisors to the incisal edge of the lower central incisors, when the upper incisors are placed more anteriorly. It is made in centric occlusion. Only the largest overjet is recorded. A Boley guage or metric ruler can be used.

![Anterior Maxillary Overjet Diagram]

8. **Anterior mandibular overjet (in mm)**
This trait is recorded when any lower incisor protrudes anteriorly, or labially, to the opposing upper incisor. The largest mandibular overjet is recorded to the nearest whole millimeter.

![Anterior Mandibular Overjet Diagram]
9. **Vertical anterior openbite (millimeters)**

Measurement of anterior openbite is made from the incisal edge of the upper incisors to the incisal edge of the mandibular incisors, measured in a vertical direction. The largest openbite to the nearest whole millimeter is recorded.

![Vertical Anterior Open Bite Diagram]

10. **Anterior-posterior molar relation.**

Normal is assessed as being a Class I relationship, i.e. the mesio-buccal cusp of the upper first permanent molar occludes in the buccal groove of the lower first permanent molar (Angle 1907). The right and left sides are assessed with the teeth in occlusion and only the largest deviation from normal molar relation is recorded.

0 = normal molar relation (Class I)

1 = Lower first molar on **either** side is 1/2 cusp either mesial or distal to the upper first molar.

2 = Lower first molar on **either** side is one full cusp or more either mesial or distal to the upper first molar.
If the assessment cannot be based on the first molars because one or more are absent, not fully erupted, or misshaped because of extensive decay or fillings, the relations of the permanent canines and premolars are assessed.

LEFT SIDE POSTERIOR OCCLUSIONS

ASSESS RIGHT SIDE OCCLUSIONS SIMILARLY

NORMAL - CODE: 0

LOWER MOLAR/CANINE
1/2 CUSP DISTAL - CODE: 1

1/2 CUSP DISTAL -

LOWER MOLAR/CANINE
ONE CUSP OR MORE DISTAL - CODE: 2

LOWER MOLAR/CANINE
1/2 CUSP MESIAL - CODE: 1

LOWER MOLAR/CANINE
ONE CUSP OR MORE MESIAL - CODE: 2

11. Total (DAI score)
Calculated as previously discussed.
General Comments concerning the DAI:

Examiners should try to be objective in assessing the DAI index for any patient. A measuring instrument such as a periodontal probe, or a metric ruler should be used in any examination and assessment. When in doubt, always assign the lesser score (Cons et al 1986).

The authors (Cons, Jenny, and Kahout, 1986) claim that the DAI is:

1. **Valid**: Due to rigorous cross-validation carried out in the DAI development. It has been shown to be relevant cross-culturally.

2. **Objective**: Ten orthodontic traits are objectively measured.

3. **Reliable**: Inter-examiner reliability and intra-examiner reliability has been shown to be good.

4. **Equitable**: The scoring is completely unbiased and ranks only according to the severity dictated by the social norms used in devising the index.

5. **Inexpensive**: It can be used by dental auxiliaries. No special instruments are needed (except for a metric measure).

6. **Speedy**: All 10 traits can generally be recorded in less than 2 minutes in the field. Special clinical conditions are not required to enable good recordings.

Criticisms of the DAI

The DAI does have weaknesses. It does not address skeletal problems in the dentofacial region (Mylchreest 1990), although measurement of vertical and horizontal interincisor relationships does address this
problem of assessing skeletal variability. Skeletal problems may be inferred indirectly from measurements of molar relationship and overjet measurements.

Another possible criticism is that the DAI concentrates only on 10 aesthetic-related traits. Relevant items, such as midline deviations, and posterior crowding are not formally assessed, although the recording form does make provision for further examiner comments.

Vertical anterior openbite is recorded as part of the assessment. Prahl-Anderson (1978) found little evidence for aesthetic preference to the presence or absence of anterior openbite when occlusal traits were being assessed by lay assessors. The contributing regression coefficient to the DAI for anterior openbite weights it fairly heavily despite these findings. One may conjecture about whether the U.S. developed DAI should be made more applicable to Australia by similar regression analysis of a similarly developed sample.

Summary.
The Dental Aesthetic Index is a recently developed occlusal index that involves the assessment of ten occlusal measurements. Its design and calculation method aim to reflect the social acceptability of a patient's dental appearance. It has been shown to be a valid index in surveys that vary in location and population background. Freer (1989) commented that the Dental Aesthetic Index "goes back to the fundamental principles espoused by Bjork, Solow and Helm and subsequently by Working Group II of the WHO/FDI commission" in collecting soundly based epidemiological information concerning malocclusion. Its authors (Cons et al 1986) suggest that different racial and cultural groups share a common conception of
beauty, and that norms for acceptable dental appearance vary little between countries (Cons et al 1989).
On balance, the Dental Aesthetic Index was therefore seen as an appropriate malocclusion for use in the field survey conducted as part of this thesis.
CHAPTER SIX

DEVELOPMENT OF THE QUESTIONNAIRE.

Introduction.
The questionnaire finally used in the field survey of this thesis underwent the process of development, pilot testing, revision, further pilot testing, and then acceptance for use in the field survey.

The initial questionnaire.
The initial questionnaire was developed after discussion and consultation with a number of people. Discussions were held with Associate Professor K. Godfrey, the supervisor of this thesis, in respect to the type of information being sought. Advice concerning the questionnaire construction and its aims was sought from two psychologists of the Child Development Unit of the Community Health Centre, Tamworth, New South Wales.

The initial questionnaire investigated a number of areas of interest regarding a person's self-perception of their teeth. These areas of interest were:
1. The straightness of a subject's teeth
2. The colour of a subject's teeth.
3. The cleanliness of a subject's teeth.
4. The presence of decay ( according to the subject's self knowledge )
5. Whether or not the subject's gums were healthy.
This questionnaire sought to enable the respondents to provide a graded response to some questions, therefore enabling assessment of the depth of intensity of a subject's opinion. Some questions also allowed for open responses. It was anticipated that these would enable collection of information from the questionnaire respondents without restricting the subject's answers too much. It was acknowledged that such responses would be difficult to score accurately, but that the information obtained could be useful.

Questions that varied in difficulty were deliberately included in the initial questionnaire. It was thought that results obtaining anything other than a low rate of non-formal or inappropriate response would be an indication that a particular question required too high a level of comprehension for the age group (10 to 12 years) being surveyed. A high level of informal response to a question would indicate that question required revision or re-assessment.

The Initial Questionnaire.

Q1. Do you have any worries about your teeth - even a small worry?
   (circle your answer)

   yes / no

Q2. When you look at other people's teeth, what things do you like about their teeth?
   (circle your answer)

   colour   cleanliness   no decay   straightness   healthy gums
   yes/no    yes/no        yes/no    yes/no         yes/no
Now number these likes in order of importance, by numbering each box from 1 to 5. Place number (1) in the box you consider to be the most important feature, through to number (5) in the box for which you think is the least important feature.

colour cleanliness no decay straightness healthy gums

Q3. When you look at other people's teeth which things don't you like about them? Number the boxes from (1) to (5) with the most important dislike being number (1) and the least important number (5).

no decay healthy gums straightness colour cleanliness

Q4. What do you think about your own teeth? If you don't like something about them, list the dislikes in order of importance with (1) being the most disliked feature. Each box must have a number.

cleanliness straightness no decay healthy gums colour

Q5. Are these your own ideas about the way your teeth look? (answer each question 'yes' or 'no'.)

or also:

your families yes/no
your friends yes/no
your teacher yes/no
your dentist yes/no
school dental nurse yes/no
anyone else

Who? __________________

Q6. Out of all these people, whose opinion about your teeth is most important to you?

Answer:__________________
Q7. If you don't like the look of your teeth, would you like to have something done about them?

yes/no

If yes, what would you like done?

Q8. How satisfied are you with the appearance of your teeth? (circle one answer)

very satisfied
quite satisfied
just satisfied
not satisfied
very unsatisfied

Q9. Compared to your classmates, how do you think your teeth look? (circle one answer)

well above average
above average
average
below average
well below average

Q10. How satisfied are you with the appearance of your smile? (circle one answer)

very satisfied
quite satisfied
just satisfied
not satisfied
very unsatisfied

Q11. How would you consider your teeth look as compared to your entire face? (circle one answer).

very satisfied
quite satisfied
just satisfied
not satisfied
very unsatisfied

Sample Group Used to Pilot Test the Initial Questionnaire

The initial questionnaire was field tested on a sample of 82 subjects. All subjects were aged 11 years at the time of the pilot test. The sample group of 82 comprised 44 females and 38 males. The subjects all attended the same school on the North Coast of New South Wales. The subjects were overwhelmingly of Australian Caucasian background, and had no apparent difficulty understanding English.

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Written consent for their child to participate in this survey was obtained from each parent or guardian through the co-operation of the school.

Materials used in the Pilot Test.
Questionnaire forms
Answer forms
Pencils

Physical location of the Pilot Survey.
The subjects answered the questionnaire in their own classrooms in their normal class size, i.e. groups of about 25 subjects.

Each class was introduced to the questionnaire by the supervisor (Dr. R. Mylchreest-Graduate student in Orthodontics), who gave a brief explanation as to the purpose of the questionnaire, which was "simply to find out what each person thinks about their teeth". The method of answering the questionnaire was also briefly discussed. The subjects were asked to complete the questionnaire in silence, without checking each others' answers.

Results of the initial questionnaire pilot test.
The results obtained from the pilot test of the initial questionnaire showed the questionnaire itself and its administration had a number of problems.
Some of the problems that arose were directly related to difficulty of supervision of such a large group of subjects. The request from the supervisor (Dr Mylchreest) to the group of subjects for silence while the questionnaires were answered was not met, and it proved to be difficult in the particular setting used for the supervision of the subject groups to be adequate. The subjects talked amongst themselves and also compared answers while answering the questionnaire.

As an overall group, the respondents had difficulty in answering the questionnaire completely. In all, 29% of the sample group (24 of the 82 subjects) failed to answer all of the questions.

The only questions answered without apparent difficulty by all 82 of the respondents were Questions 1, 2, 8, 9, 10, and 11.

Questions 6 and 7 call for open responses. A total of 19 respondents failed to answer either of these two questions.

Of those respondents who did answer them, the answers were difficult to interpret or categorize and proved almost impossible to score or quantify in any way.

The wide areas of opinion sought through the questionnaire concerning the subjects' self-perception of their teeth may well have confused them. The concepts explored in the questionnaire, such as:
'straightness of teeth',
'appearance of teeth',

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'whiteness of teeth',
and so on, appeared to be too overlapping to allow useful interpretation of
the subjects' answers. In many cases the author thinks the subjects
failed to answer the questions due to this confusion.

The last four questions asked were similar to those asked by the Eastman
Esthetic Index. They were answered in a closed response manner/option
with graded responses available to the respondents.

These four questions are unambiguous and were all answered by all but
one of the 82 subjects. The actual answers themselves were not analysed
in detail, as this author felt that the problems associated with the
answering of the questionnaire previously discussed meant the answers
were of little value.

Conclusions.
A number of conclusions resulted from the pilot test of the initial
questionnaire.
1. The first conclusion, perhaps, is that this author was somewhat out of
touch with the comprehension and writing ability of 11 year old
schoolchildren. The level of overall difficulty of the questionnaire was too
high for the age group of the respondents.
2. Secondly, the open type answers were found to be not well handled by
the respondents.
Open-type answers are only useful when used by people who are happy
expressing themselves in writing, and doing so succinctly (Moore 1987).
Open-type answers can (and did in this initial pilot test) produce a wide range of answers that proved to be difficult to categorize and thus to analyze.

Open type answers require more effort from the respondent than closed type answers, and are less likely to be completed (Moore 1987).

3. The third conclusion drawn from the pilot test was that the supervision of the questionnaire administration was inadequate. In retrospect, the groups of subjects should have been divided into smaller groups and a more disciplined environment established for the subject groups.

4. The performance of the children in this pilot trial of this initial questionnaire indicated that it would require more modification than had been expected.

A further questionnaire was then constructed ready for pilot testing, using those questions reliably answered in the first pilot test, plus addition of other questions.

Revised questionnaire

The revised questionnaire consisted of the following questions and answer options.

PATIENT NUMBER
AGE
MALE/FEMALE

Please circle only one answer to each question. It is important to answer all questions.
Q 1.
Do you have any worries about your teeth, even a small worry?

yes / no

Q 2.
How do you think your front teeth look?

very quite average not very bad
good good good

Q 3.
How happy are you with the appearance of your teeth?

very quite just not very very
happy happy happy happy unhappy

Q 4.
Compared to your classmates, how do you think your teeth look?

very reasonably average not very bad
good good good
Q 5.
How do your classmates make you feel about your teeth and your smile?

very       quite       average       not very       bad
good       good        good

Q 6.
Do you ever try to hide your teeth when you smile?

yes / no

Q 7.
How does your family make you feel about your teeth and your smile?

very       reasonably       just       a bit       very
happy      happy           OK        unhappy      unhappy

Q 8.
Do you think your parents would like you to have braces to straighten your teeth?

yes / no /
Q 9.
Are you interested in having braces?

yes / no

Q 10.
If you are interested in having braces, how interested are you?

very interested   reasonably interested   not very interested   not at all interested

Q 11
Have you ever been teased about your teeth or your smile?

yes / no.

This questionnaire, (which after pilot testing was accepted for use in the thesis survey) aimed to gather specific information of cross-related areas of interest concerning:

1. The subject's self-perception of his or her teeth and smile.

2. Whether or not the subject had ever experienced unfavourable peer pressure concerning the appearance of his/her teeth or smile.

3. Whether or not the subject had ever experienced unfavourable family or parental pressure concerning the appearance of his/her teeth or smile.
4. Whether or not the subject had ever experienced family or parental pressure or encouragement to have orthodontic treatment.

5. Whether or not the subjects had any interest in having orthodontic treatment, and if so, the degree of his/her interest.

6. If the subject had an unfavorable self perception of his/her teeth or smile, to detect the degree of this negative self-perception.

The second questionnaire used questions that were far more simple than those used in the first questionnaire. Strong efforts were made to keep the language and syntax of the questions and the answer options as simple as possible, consistent with obtaining the information being sought. Some questions were deliberately designed to be slightly repetitive in the type of information they intended to gain. This approach was needed because the concepts being investigated could be examined from different angles. For example, parental pressure encouraging the subject to have braces and the subject experiencing unfavourable family pressure concerning their teeth or smile are two slightly different aspects of the same problem.

The answer choices available to the respondents in the second questionnaire provided either a "yes" or a "no" response, or a graded response if shades of opinion were intended to be measured. The order of the questions was mixed to avoid leading the respondents in
any particular way.

The question thought by the author to be potentially quite evocative: "Have you ever been teased about your teeth or your smile" was left until last, with the intention of minimising any possibility of leading the respondents in any particular way.

Comments sought about this revised questionnaire from the child psychologists from the Community Health Centre, Tamworth, reinforced this author's view that these questions should be easily read, comprehended, and answered by subjects in the age groups being surveyed.

Avoiding any open-type responses facilitated straightforward scoring. The range of closed responses available to the respondents was intended to present a sufficiently broad choice to enable the respondent's answer to be accurately expressed.

Pilot Test of the Revised (second) Questionnaire.

Materials used
Questionnaires
Answer forms
Pencils
Location

This questionnaire was pilot tested with 20 subjects at the Tamworth State Orthodontic Clinic by the author over a consecutive 3-day period.
The questionnaire was constructed to have only one question per page of the questionnaire. It was felt by the author and supported by writings by Moore (1987) that this would ensure the subjects would concentrate on that question alone, and that this would minimise the influence of the preceding question or questions on the answer the subject gave.

A full copy of the actual set-out of the questionnaire used in this pilot test (and subsequently in the survey field survey itself) can be found in Appendix I.

**Physical Location Of the Second Pilot Test.**

A total of twenty subjects answered the questionnaire for the pilot test. Verbal permission from a parent for the subject to answer the questionnaire was sought and obtained.

The subjects were all siblings of patients currently undergoing dental treatment at the Tamworth Dental Clinic. Of the twenty subjects, fourteen were aged 11 years, and six were aged ten years of age. There were thirteen females and seven males.

The subjects all singly completed the questionnaire being tested in a small private office in the Dental Department of the Community Health Centre, Tamworth.

The author briefly explained the purpose of the questionnaire, which was stated as "wanting to find out what you think about your teeth".
Instructions as to how to answer the questionnaire were kept to a minimum, but covered the following points.

1. Each subject was asked to answer the questionnaire in silence.
2. The subject was asked to answer each question in order before proceeding to the following question.
3. The subject was asked to circle their answer on their answer sheet.

No time limit was given to the subjects, but they all answered the questionnaire in two minutes or less.

**Results of the Pilot Test of the Second Questionnaire.**

All 20 subjects completed the questionnaire without difficulty. All questions were answered. All subjects indicated via verbal feedback sought by the author immediately after completion of the questionnaire that the questions were easily understood and that the questionnaire answer form was easy to follow and use.

The actual answers of the questions were not analyzed other than for checking compliance.

This second questionnaire attracted favourable comment from the advising psychologists, and also from the local Dental Therapists and other orthodontic postgraduate students.

The method that was used to administer the questionnaire is outlined fully in the method section of this thesis.
CHAPTER SEVEN

EXAMINER CALIBRATION

INTRODUCTION.
The anticipated large number of patients that were expected to be examined (300 to 400) and the relatively short time available (two days) over which the examinations could be conducted meant that two examiners were required if all consenting patients could be examined.

The two examiners who conducted the survey were:
1. Dr Peter Synnott (the author) and

2. Dr Katherine Arneman (postgraduate student in the M.D.Sc. programme in orthodontics at The United Dental Hospital).

REQUIREMENTS OF THE EXAMINER CALIBRATION
For the DAI survey results to be reliable both examiners had to calibrate their scoring of the DAI prior to the field survey itself.

The DAI protocol clearly states the required examiner reliability guidelines that need to be met in survey use of the DAI. The DAI protocol states that:

It was determined that intraexaminer and interexaminer DAI scores were reliable "when 90% of the differences in DAI scores between the first and second trials (using DAI scores on orthodontic models) were 4 points or less." (Cons et al 1986)
The first and second trials referred to in this preceding quotation relate to the DAI scoring of sets of orthodontic study models by any examiners undergoing calibration.

The DAI protocol required that models were all be scored in the one time session for any one trial. It also required that the two scoring trials were held one week apart.

The same sets of orthodontic study models needed to be used in both scoring trials.

EXAMINER CALIBRATION METHOD
The method used for examiner calibration in this thesis followed the DAI requirements for examiner calibration. The calibration process required several steps.

Step 1. Study of the Dental Aesthetic Index

Study of the DAI protocol was conducted by the examiners (this author and Dr Arneman) both individually and then collectively. The protocol was studied until both examiners were fully conversant with all the occlusal indicators to be scored, as well as with the method of scoring to be used.

Familiarity was also gained with the DAI scoring forms, and with the method of calculating a DAI score for any given set of study models or patient.
The occlusal parameters used in the DAI were clearly defined in the DAI protocol, and proved to be fairly straightforward to score. However, the scoring of the molar relationship using Angle’s Classification was not always clearcut. The molar relationship for any given set of study models (or subject) could sometimes differ between left hand side and right hand side. The molar relationship could also be on the borderline between e.g. a Class I relationship and a half unit Class II relationship.

In scoring the molar relationship the principle used, as with all the dental parameters scored as part of the DAI assessment, was the principle as stated by the authors of the DAI, that: "where there is any doubt as to an occlusal measurement, the lesser score should always be assigned." (Cons et al 1986). To illustrate this principle, the following examples can be used.

**Example 1:**
If the molar relationship on the right hand side was Class I, and on the left hand side was Class II, the molar relationship was scored as Class I. A Class I molar relationship scores 0 on the DAI scoring system, whereas a Class II molar relationship (full unit) contributes to a higher score (2) on the DAI scoring system.

**Example 2:**
If the molar relationship on the right hand side was Class I, and on the left hand side was a half-unit Class II, or a half-unit Class III, the molar relationship would be scored as Class I. This is because a Class I molar relationship contributes a score of zero to the DAI, whereas a half-unit Class II or a half-unit Class III molar relationship contributes to an increased DAI score.
Example 3:
If an overjet measurement was between 4mm to 5mm, the score of 4mm would be recorded.

Where there is any doubt, the lesser score is always assigned. This scoring requirement, therefore, tends to minimise the DAI score obtained for any set of orthodontic study models or patient. Full descriptions of the occlusal parameters measured in calculating the DAI are discussed in the thesis chapter "The Dental Aesthetic Index."

Step 2. Trial scoring of study models.
The second step followed in the examiner calibration involved scoring sets of orthodontic study models using the Dental Aesthetic Index.

STUDY MODEL SELECTION.
Ten sets of pretreatment orthodontic study models were used from patients that had been accepted as requiring treatment by the Graduate Orthodontic Clinic of The United Dental Hospital, Sydney. The ten sets of pretreatment study models were chosen unseen. The method of choosing involved each examiner choosing every fifth model box from a storage shelf from the Graduate Orthodontic Clinic, with each examiner choosing 5 sets of study models.

All models had been trimmed to orthodontic presentation standard. No models had chipped or broken teeth, and all were clearly labelled with an identification number or name. By chance, the ten sets of study models chosen represented a range of malocclusions.
First trial for Examiner Calibration.

Each examiner scored each set of study models individually, and scored all ten sets in the one time session.

Equipment and materials used for examiner calibration trials. Only simple equipment was required, and consisted of:

1. blue and red ball point pens (one colour for each examiner)
2. small flexible plastic rulers graduated in millimeters
3. ten sets of orthodontic models.
4. DAI scoring sheets.

The study models were scored without discussion of any type between the examiners until all ten sets had been scored by both examiners. The rooms used were well lit by both natural daylight and overhead lights.

A separate DAI scoring form was used for each set of study models by each examiner. When subsequent scoring of the models was conducted new forms again were used to record the DAI scores.

When the ten sets of study models had been scored by both examiners, the DAI for each set of study models was calculated (method previously discussed in the chapter titled "The Dental Aesthetic Index").

The scores of each set of study models was then compared between the examiners. Differences between any measures scored where then
discussed and resolved.

Second trial for the examiner calibration.
The same procedure of model scoring and DAI result comparison was followed for the same ten sets of study models five days later. The same rooms, equipment and materials, and the same method was used in the second trial as was used in the first trial.

The models were scored in a different order to minimise any memory the examiners had of scores obtained during the first trial. However, both examiners commented that they could remember none of the measurements scored in the first trial.

Results of the examiner calibration trials.
The calculations resulting from these trial DAI scorings show that the inter-examiner and intra-examiner reliability between the two examiners was within the accepted error rate as set out by the DAI protocol, as shown in Table 7.1 and Table 7.2.

Intra-examiner reliability
The intra-examiner reliability achieved in this calibration showed a DAI calculation rate difference of less than 4 points in more than 95 % of the DAI assessments. The results of both examiners are included in Table 7.1
<table>
<thead>
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<th>Differences in DAI scores between 1st and 2nd trials</th>
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<th>Cumulative Frequency</th>
<th>Percent</th>
<th>Cumulative Percentage</th>
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Table 7.1 Results of assessment of intra-examiner reliability of the examiner calibration trials.

Inter-examiner reliability.
The inter-examiner reliability achieved in this calibration showed a DAI error rate of less than 4 points in all cases examined (i.e. 100% of the models). The results of both examiners are included in Table 7.2.

<table>
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<th>Differences in DAI scores between 1st and 2nd trials</th>
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<td>100</td>
</tr>
</tbody>
</table>

Table 7.2 Results of assessment of the inter-examiner reliability from the examiner calibration trials.

Conclusion from examiner calibration trials:
As a result of the process of examiner calibration followed, both examiners were confident that their DAI scoring methods were acceptable from both the point of view of intra-examiner reliability and inter-examiner reliability.
PATIENT CONSENT

Written parental or guardian consent was obtained for all children examined and surveyed during this thesis study.

Each parent or guardian was asked to sign a form to the effect that they:

"agree to the dental examination and survey of my child by an experienced member of the Regional Dental Service, New England Region".

Other information obtained from the consent form included:
Patient's name.
Patient's School.
Patient's Class.
Patient's Date of Birth.
Patient's Age.

One consent form was given to each child of the appropriate age in the school and sent home for the parent or guardian to sign at least one week prior to the anticipated examination date.

Each signed form was then collected by the class teacher. Immediately prior to the dental examination, each child was given their signed consent form, and the child then presented that form to the examiner concerned.

No child participated in this survey without written consent.
CHAPTER EIGHT

STUDY METHOD.

The study method was divided into two (2) parts.

The first part consisted of the administration of the questionnaire for each subject. The second part consisted of the scoring of the Dental Aesthetic Index for each subject.

Part 1:

THE QUESTIONNAIRE ADMINISTRATION.

It was anticipated (and in fact proved to be the case) that a large number of subjects would need to be surveyed in a relatively short space of time.

Because of these factors, it was decided to administer the questionnaire in subject groups of ten (10) in tightly controlled and supervised conditions. The tight control was deemed necessary to maximise the accuracy of the survey questionnaire results.

The rooms that were available for the questionnaire administration varied between the different school locations. They consisted, however, in all instances, of rooms large enough to enable the subjects in each group of ten to be physically separated.

In most of the school locations the children were provided with a school type desk and chair. In those locations where this was not possible the subjects were seated on the floor of the room. All the physical locations used provided reasonable comfort for the subjects.
Strong efforts were made by the examiners and the questionnaire supervisors to create an atmosphere which was conducive to the subjects answering the questionnaire in a disciplined manner. This was achieved by the physical spacing of the subjects, the verbal request from the supervisor that the subjects be silent, and the continued presence of the supervisor in the room.

The room sizes (and desks and chairs) allowed for the subjects to be sufficiently well-spaced to prevent any discussion of the questionnaire between respondents, and also prevent any copying of answers.

Class teachers at each school were asked to send a group of ten children at a time to the rooms where the questionnaires were to be administered. The children were then seated, and then each subject was given the following items:

- one complete copy of the questionnaire,
- one answer form, and
- one sharpened pencil.

The supervisor of each group of ten was a member of the survey team, in most instances, a Dental Therapist. A verbal explanation from the supervisor covered the following points for each group of 10 subjects:

1. The aim of the questionnaire was stated. It was explained that the questions aimed to find out what each child thought about the appearance of his or her teeth.

2. It was clearly explained that the questionnaire was not a test, and that the children's names were not wanted on the answer forms.
3. The children were firmly asked by the supervisor not to talk to anyone else in their group. They were also asked not to try to look at anyone else's answers, but to answer the questions so that they expressed their own opinions. If any of the subjects had any problems or questions during the answering of the questionnaire, they were asked to direct their question to the supervisor, and not to anyone else.

4. The subjects were asked to answer each question honestly.

5. The subjects were asked not to take too long in answering the questions, but at the same time to answer them carefully.

After these points had been explained, the subjects were then asked to look at their individual answer sheet. It was explained that each page of the questionnaire had only one question, and that each question must be answered before turning over the page to the next question. The subjects were asked not to mark the questionnaires in any way, but to circle their answer to each question on their own answer sheet.

When each subject finished the questionnaire, they were asked to give both the questionnaire and pencil to the supervisor. The supervisor did not check whether or not each subject had answered all the questions. The compliance factor was left to each individual subject.

Each subject then took their completed answer sheet to the examiner for the assessment of their Dental Aesthetic Index.
Comments relevant to the questionnaire administration:

Two groups of ten subjects were timed as to how long they took to complete the questionnaire. The shortest time taken was about 50 seconds, and the longest time taken was about 4 minutes. Most of the subjects took approximately two (2) minutes to answer the questionnaire.

Very few children needed further instructions (other than those already given) to be able to answer the questionnaire. The discussion section of this thesis outlines the subject compliance more fully, but it may be of relevance to mention at this point that only 3% (9) of the survey forms were not fully completed.

Part 2

Scoring of the Dental Aesthetic Index for Each Patient

Materials and equipment used.
Dental mouth mirrors
Disposable examination gloves.
Small flexible plastic rulers (graduated in millimeters).
Portable electric dental examination lights
Alcohol wipes.
Wavicide gluteraldehyde sterilization liquid and clean water rinse.
Dental Aesthetic Index scoring forms
A medium size desk and two identical chairs (placed on adjacent sides of the desk)
The dental examination and scoring of the Dental Aesthetic Index of each subject was conducted in a room separate from that used for the questionnaire administration. The rooms chosen for the DAI scoring had good natural daylight. Portable dental examination lights were also available. Subjects were examined and assessed one at a time.

The subjects waiting for assessment were asked to wait in an adjoining area or a separate but adjacent room, well away from the person being assessed. This arrangement provided a quiet and controlled environment for the examiner assessing the subject's DAI, and also afforded the subject a measure of privacy from their classmates.

The examiners (two in number) worked in separate rooms in conducting the DAI assessments.

The examiner ensured the subject was comfortably seated, and then briefly introduced himself or herself. The purpose of the examination was stated, and was expressed as a way of checking on the way that person's teeth were growing.

The DAI scoring form was used to record the subject's:
- age (on that particular day)
- sex
- and race

The race was recorded as non-Aboriginal or Aboriginal in almost all cases, although some subjects of Asian background were examined. The overwhelmingly majority of subjects were non-Aboriginal.
The questionnaire answers were indicated by each subject on the reverse side of the DAI scoring form used by the examiner, a sheet separate from the questionnaire itself. This meant that the examiner was not familiar with any of the answers given by the subjects in response to the questions asked during the questionnaire. This avoided any tendency either examiner may have had to assess a high DAI score if they felt or suspected that the subject had recorded a strong desire for orthodontic treatment or strong dislike for their dentition in responses to the questionnaire, or conversely to record a low DAI score for a subject apparently satisfied with their dentition.

The examiner then examined each subject, assessing and recording the ten occlusal measurements used in scoring the DAI. All occlusal parameters were measured as required by the DAI protocol. These have been discussed already in Chapter Five titled "The Dental Aesthetic Index".

The order of assessment of these measurements and their order of recording was exactly that as required by the DAI scoring protocol, i.e.:  

1. Missing incisor, canine and premolar teeth.  
2. Crowding in the incisal segments.  
3. Spacing in the incisal segments.  
4. Diastema.  
5. Largest anterior irregularity. (Maxilla)  
6. Largest anterior irregularity. (Mandible)  
7. Anterior Maxillary overjet.  
8. Anterior Mandibular overjet.  
10. Antero-posterior molar relation.
Each clinical examination took approximately one minute. This time varied, taking longer for subjects who had a more difficult assessment, and was sometimes shorter for subjects who had a more straightforward assessment. Plastic rulers were used to check overjet measurements.

**Examiner Calibration:**

In an effort to give continuing checks on the inter-examiner reliability of the DAI assessments approximately every thirtieth (30th) subject was examined and assessed by both examiners, and any difference of the occlusal measurements of these particular subjects was discussed and reconciled at the time, with little if any difference in the DAI assessments being found.

After each subject was assessed, they were thanked for their participation in the survey by the examiner. The subjects then returned to their classrooms.

**Calculation of the Dental Aesthetic Index.**

Each evening the Dental Aesthetic Index was calculated for each subject assessed during the day according to the formula set out by the DAI protocol.