

Editor's Newsletter

Dear Colleague,

In this issue we shall consider a method of monitoring our practices, as promised in the last newsletter. This method will indicate the frequency of various problems. Having decided which problems we may wish to tackle, the following section attempts to formalise a system of clinical problem-solving. This is primarily a qualitative approach, so it will be followed by the start of a number of useful numeric approaches. These latter methods will become more relevant as more orthodontists install computers in their practices.

Practice monitoring

Two exercises are suggested as 'homework' until the following issue. The first one is a simple method of critically monitoring one's practice. The results from using this method in my practice were presented at the combined Australian-Japanese Begg meeting in Alice Springs. Those present at that meeting may recall that it produced some *surprises*. In other words, the occurrence of certain problems were far more frequent than casual impressions had suggested. Having highlighted them by this means, it was a relatively easy matter in most instances to eradicate or minimise these problems. Their nature and the solutions will be presented in the next issue. But the monitoring procedure can be recommended now for your practice.

Firstly, determine the usual span of time between visits for active treatment. Assume for the moment that this is four weeks. Choose a fairly representative period of four weeks in your practice, that is, do not include a holiday period. Have your secretary prepare spare day sheets for this period so that there is sufficient space for written comments to the right of each patient's name.

Assume that we are considering clinical procedures rather than practice management procedures. Write all critical comments or treatment problems to the right of each patient's name, for example, loose upper right molar band, distorted archwire, poor oral hygiene, not wearing elastics, bracket on upper left lateral positioned too incisally, etc. Since these sheets need not be shown to anyone else, the comments may be hyper-critical. At the end of each day the sheets are placed in one's personal drawer.

At the end of the four week period, the sheets are collected and analysed. That is, compile the incidence of each problem and indicate those which are highly significant - by significant, one would mean in a medicolegal sense. For example, a premolar slightly over-rotated may be of nuisance value, but a significant finding would be a high incidence of root resorption associated with a particular procedure or mechanism. This method of clinical monitoring is subjective and does not incorporate a formal error analysis so it could not be classified as research. But we are interested at this stage in a quick practical method to highlight the incidence of one's problems. It would be worthwhile keeping the results to compare with similar studies in subsequent years to confirm improvements.

Clinical Problem-solving

In the last newsletter, by definition, problem-solving fell between a 'cookbook' approach and research. In fact, it was stated that the main difference between problem-solving and research was that the former sought particular answers and the latter sought general answers. It would be worthwhile therefore looking at various devices built up over the years by scientific research to see how it may be possible to build for ourselves a system of clinical problem-solving. And we shall find that the three cardinal attributes are *thoroughness, honesty and perseverance*.

A most interesting discussion on the similarities and differences between science and commonsense is presented by Elliot (1974). Firstly he recapitulates Nagel's (1961) six differences between science and commonsense, and then goes on to raise four points which indicate that commonsense is an *integral* part of science. In effect then, he reiterates the premise in the last Editor's newsletter, namely, that research should be a nice blend of qualitative and quantitative aspects. Apart, from this basic principle, his specific points are well worth pondering in relation to orthodontics.

"Commonsense entertains incompatible and inconsistent beliefs ... (but)... on occasion, *incompatible* assumptions... can greatly aid in the shaping of scientific inquiry" It is generally held by experienced clinicians that the two major techniques used in this country are incompatible throughout much of the treatment. But it is usually a warming experience to discuss the similarities and differences of each other's technique with a friend and colleague. Whilst the mechanical aspects may differ, it is amazing how much there is in common taking the overall picture. An example of this was the dissertation on intrusion by McDowell (1967). A comparison of the two techniques leads to a separation of principles from procedures, as will be discussed later.

Yet another point from Elliot is that 'While commonsense lays justifiable claims to accurate knowledge, commonsense is frequently not aware of the *limits to the range of validity* of its beliefs, or the *range of success* of its practices.' The first orthodontic example which comes to mind is the long term success of our treatment. There are logistic limitations as to how long we can keep each patient coming back for review and records, just as it is unrealistic to survey every person in a city the size of Melbourne, because the cost would be several million dollars. Therefore we need the help of statistics to provide correct sampling to produce valid conclusions. This contrasts with the hit and miss sampling from, for example, a previous patient returning to one's practice accompanying a younger sibling. To produce a realistic view of one's long term results or other matters, read pages 41-46 of Langley (1979) where he discusses random sampling and sample size very clearly and succinctly. Moroney (1962) confirms the need for common sense and background experience for valid statistics on pages 187 and 218.

A most desirable ingredient for problem-solving is a good *working knowledge* of the subject being considered; or to put it in 'expert systems' language, to have domain-specific knowledge. One must distinguish between knowing and 'rote' memory. The difference between these two has been written about from antiquity to the present, from Seneca to Sowa (1984) who lists the differences. These differences are exactly the same as those between a 'cookbook' approach and problem-solving approach, discussed in the last newsletter. This ingredient of a sound working knowledge of the subject allows mental separation of a procedure from its underlying principle/s. For an example, consider initial alignment of the teeth. There is a plethora of procedures in orthodontics for aligning teeth. Even each technique has many aligning procedures. The two emerging principles are light forces and minimising untoward root movement. Firstly, with rectangular wires, one may use loops in non heat-treated wire or low force value wires (titanium alloys) to implement these principles. Sectional wires, by their cantilever application, also reduce force values. Secondly, in round aligning arches, dramatic reductions in force values may be achieved by braided

wires or wires of extremely fine dimensions (.22 mm or .009 in), with high tensile properties. These very low forces minimize the pivoting of the tooth on the alveolar crest and consequently the root apex is not thrust in the opposite direction. Thus ultra-light forces control untoward root movement in a passive way.

Procedures take into account such aspects as ease of forming of wires, problems of irritation etc. Whilst these are most important in a practical sense, it is valuable to have clearly separated the underlying principles in one's mind for problem solving. Such a mental separation is enhanced if one has tried various techniques over the years.

One of the objectives of research is to look at all the factors or variables. This thoroughness should also apply to problem-solving. Naturally, in the clinical situation when dealing with people, one can rarely control all the variables, nor can one examine them in a randomised fashion as is required in formal research to reduce biased conclusions. Yet it is good practice to write down the problem and all the factors which may be involved, that is, the 'thinking on paper' technique. This point is valid on two grounds. The first is that most problems are not a simplistic A causes B. One knows this from experience but one may quote Godel's Theorem which states: '... in all but the simplest mathematical systems there may be propositions that cannot be proved or disproved by any finite mathematical or logical process.' (Wolfram, 1984). The second is that most of us do not have the mental capacity to hold more than four to seven factors in our mind at the one time (Sowa, 1984).

The method of documenting the problem has reportedly been discussed by Busan in a BBC series, according to Rodwell (1984). Busan's premise is that ideas may come in a haphazard fashion, yet we are expected to present them in an orderly fashion. Therefore he suggests that thoughts be documented in the first instance in a tree-like manner so that as the thoughts

arise in the conscious mind, they can be attached to the appropriate 'branch' of the diagram.

Several personal enhancements have been found useful for the 'brain dump' (Figure 1(a)). Firstly, an area should be set aside to write out the statements of the problem. The plural is used intentionally, since it is prudent to state the problem several different ways to stimulate the intellect. Secondly, it is convenient to list the terms of the so-called 'schoolboy sieve', namely, how, when, where, why, what, who, whence, and whither. This may be expanded by such terms as negative observations, literature references, lateral thinking etc. The advantage of this device is that reflections on the subject matter in these terms one by one may elicit further ideas. Thirdly, the ideas may be numbered for listing in a 'linear' manner suitable for a plan or for others to follow in a manuscript or lecture. This may be achieved by preceding each idea with an open bracket or circle to be filled in when all ideas are documented. Figure 1(b) is not a modified Busan-style 'brain dump' for comparison. It is a consideration of reducing distorted archwires in one's

"Linear" approach to solving archwire distortion		
Headings	Specifics	References, 'Rules' & authorities
1. Patient	education biteplanes	non-bruxist must be still growing
2. Wire	flexibility Materials Science	watch force values difficult to form consult metallurgists & materials scientists
3. Archform	unsupported Utility-type "merrick" piggy-backs	P. Black Bioprogressive exponents see text and Clinical Aids M. Munday
4. Combinations		

Figure 1(b). List and sub-list type schema in columns for considering the reduction of archwire distortion in the mouth.

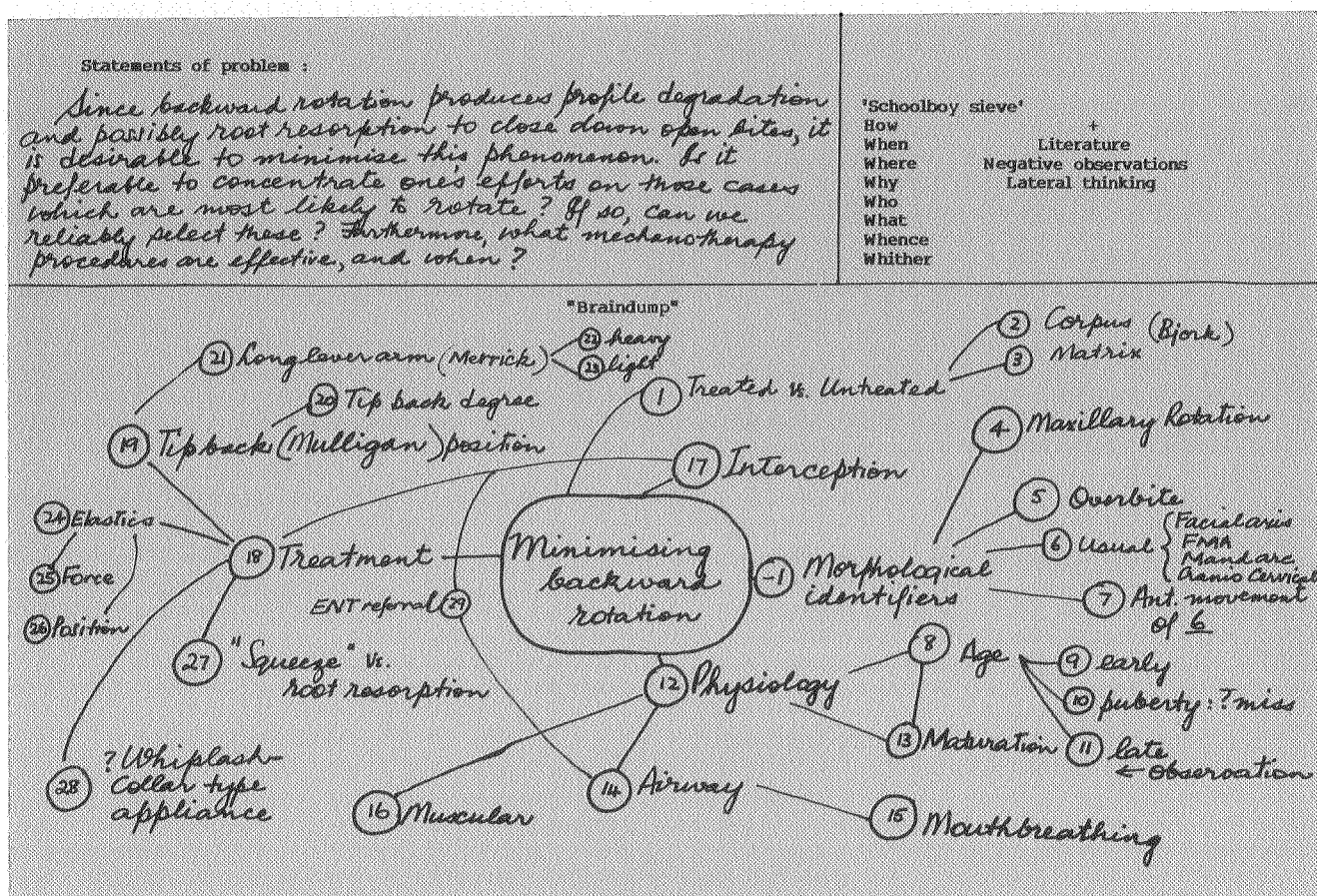


Figure 1(a). Modified Busan-style 'brain dump' for profile control by minimising backward mandibular rotation.

practice. By way of explanation, a Merrick arch wire is one which enters the lower molar tube from the distal after passing low along the buccal gingivae. Oddly, despite the span, light archwires are necessary with these to reduce mobile and rolled-in molars.

Lenat (1984) suggests that complex problem-solving draws on various methods. One may 'invoke mathematical theorems or less formal rules of thumb; ...break up the problem into more tractable subproblems, or ...reason by analogy to problems that have already been solved.' Let us consider some orthodontic examples to emphasize the points, in the order as given.

Last year this writer had the privilege of being a member of a 'think tank' to seek a materials science solution to the problem of distorted archwires. Most of the group were metallurgists and materials scientists. It emphasised the highly sophisticated mathematical approach of other disciplines which we clinicians should learn to tap by specifying our problems to these experts.

Clinical rules of thumb are rarely presented in the formal literature, except in passing, such as to disparage them. Study groups, informal discussions during or after question time at conferences, and personal visitation are the usual avenues for dissemination of the rules of thumb. Unfortunately this means they lack rigorous evaluation. The time has come to develop a methodology of evaluating the *reality* of these rules, some of which have stood the test of time and must have some validity. Simplistic statistics do not seem to be the answer.

Some clinical problems will obviously take years to overcome, so, whilst looking at the total problem to provide perspective, they could be broken into sub-problems. As an example, consider the example of trying to minimise mandibular rotation for profile control, as illustrated in the *Figure 1(a)* 'brain dump'. Obviously, the first sub-problem to tackle is to learn to recognise those patients with the potential to rotate backwards. Baumrind et al (1984) found that certain morphological traits were unreliable even to highly regarded clinicians. Not only should other anatomy be considered such as the cranio-cervical relationships (Solow et al, 1984), but physiological typing is an obvious direction to investigate more rigorously. Convenient and valid methods to quantify these characteristics are required.

As well as drawing on analogies from other sources, the experienced clinician is more likely to know intuitively which direction to follow from previous clinical analogies. Furthermore, it is reasonable to assume that the more one practices problem-solving, the more proficient one becomes. Further into the article, Lenat (1984) argues quite seriously that problem-solving depends on serendipity. But, as clinicians, we can 'enhance our luck' by writing the problem down formally to imprint it on our minds, and then return to the clinic, where further observations may point to a solution.

Looking a little in the future, another device will be available in many practices, and it would be wise to commence preparation now. This is the use of a personal computerised database of keywords of the literature. Due to obvious constraints, it is common practice in journals to limit the keywords for an article to five to seven words. But to the individual clinician, there may be dozens of significant keywords in an article. These could be circled or highlighted by the orthodontist when he reads an article, for entry into the database by his secretary. Then, when a problem arises, all the relevant articles can be recalled on his personal computer.

Once one has examined a problem in detail and comprehensively, it is usually clear what has to be done. One should write down a plan of attack in the most suitable order. But sometimes one has to make a decision on the management of the variables. Often it is more efficient to *alter a block* of variables to assess whether the influence comes from that block. Then one needs to work through that block to see which item or combination

thereof is the predisposing factor. For example, assume one has a patient with a generalised gingivitis in a clean mouth, and the history suggests a metabolic problem. Unless one can rationalise that it is a hypochromic anaemia, it may be more efficient to prescribe a multivitamin-mineral supplement. If the response is good, then one can methodically work one's way through the group. If there is no change, then one may have to consider another avenue such as a haematological referral. But one would have not wasted months going through all the vitamins and minerals separately.

Since problem-solving is a *dynamic* process it is not uncommon to have to go back to the beginning to revise the original evaluation. As the subject becomes more complex, with more factors seeming to be implicated, the subject may become confusing. If so, one may take heart from Geroch (1978) talking about theories in physics, and Einstein's general relativity in particular, on page 183. 'The view has somehow become rampant that such theories are precise, highly logical, ultimately 'proved'. But rather they 'consist of an enormous number of ideas, arguments, hunches, vague feelings, value judgments, and so on, ... connected in a complicated way ... in a *nebulous* mass taken as a whole. In presenting a theory, however, ... one is forced to rearrange it so that it is *linear* ... What is supposed to happen is that one who learns the theory, presented in this linear way, then proceeds to form his own 'nebulous mass taken as a whole'. In other words, each person has to re-create the connecting arrows in a 'brain dump' for themselves by observation and experience. One of many obvious examples in orthodontics is how the lessons from compensating bends in finishing archwires is fed back into the initial placement of brackets in subsequent cases.

The second exercise for 'homework' may provide an intellectual challenge not only to the budding orthodontic Einsteins, but also to those of us who like to mull over our problems. Chose one of the significant or frequent problems from the analysis of your practice (Practice monitoring) mentioned earlier. For those non-practising orthodontists and pseudologists who do not have clinical problems, but who wish to do the exercise, a hypothetical problem would be needed. Create the perfect problem-solving design which would indicate the total picture of this problem and its solutions. Hint: use the suggested protocol for problem-solving in the Postscripts at the end of the newsletter, and the suggestions for students' research listed in the last editor's newsletter, plus their references. The editor would welcome copies of such problem-solving designs, with a view to publishing the impressive ones.

Elementary analysis of clinical material

It may be misleading to combine groups which do not belong together for assessing trends in treatment response. After all, clinicians are trained, and find it an advantage in practice afterwards, to use *differential diagnosis*. Even to differentiate between adults and children is significant to clinical management for the orthodontist. For example, one uses lighter forces, one has no growth to exploit, etc. for the adult.

Let us consider clinical material for analysis. For example, assume that a particular treatment procedure necessitates starting at the onset of the growth spurt for success, and that it would take twelve months to complete. Assume also that one studied one's local population which revealed the average age of onset of the pubertal growth spurt to be thirteen years. This was derived from the girls averaging eleven years and the boys fifteen years (*Figure 2(a)*). If one treated at that population average (mean) of thirteen years, the chances of success with the specified treatment would be very poor, by catching only a few late developing females and a few precocious males. This shows a very simple and obvious fallacy in this hypothetical treatment where

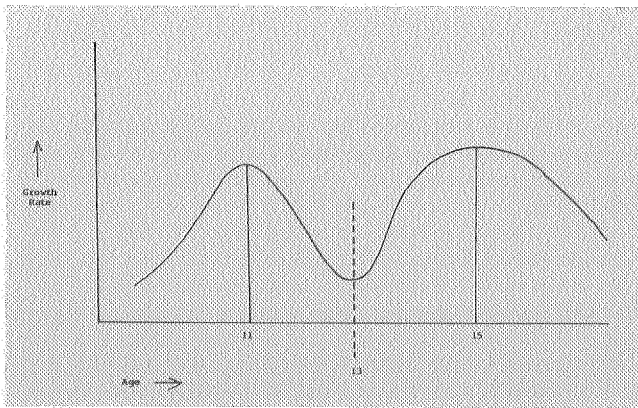


Figure 2(a). Graph showing two most frequent (modes) ages of onset of puberty for boys and girls (hypothetical). A bimodal graph. Shows 'loneliness of the mean'.

groups are combined which do not belong together. As well as this example of sexual dimorphism, orthodontists and Di Pietro (1979), a functional occlusionist, also recognise what may be termed facial dimorphism - high angle and low angle types. In clinical terms, this is differential diagnosis. But it is a common fallacy in research design to combine different groups. Therefore, one should look at all the types, factors and variables and consider their particular significance individually.

The most frequent ages for the onset of puberty mentioned above were eleven and fifteen years. Since the most frequent value in a distribution is a mode, the graph has two peaks and would thus be called bimodal. It could be that human data studied by frequency distributions is more meaningful to orthodontists than means, variance and standard deviations. Creekmore and Radney (1983) conclude that 'Frequency tables demonstrate that average growth is not normal for most persons'... and furthermore 'The average response to treatment also does not represent the manner in which most people respond.' Peruse also the illustrations in the article by Cross (1977), which showed that the same appliance therapy was associated with both forward and backward mandibular rotation in different individuals. In the past, as a profession we seem to have suffered from 'mean-mania', which suffocated productive dialogue between clinicians, researchers and statisticians. Naturally, there are times when the mean is appropriate, particularly for inanimate manufactured products where the point is to try to make them the same, and to enable quantification of the spread of phenomena. But too often the scenario is that if a definite pattern cannot be seen due to poor research design or limited sample size, the prescription is 'throw them all in together and take a mean', and to make all sorts of deductions from this one figure: just as one cannot determine an optimal orthodontic treatment plan from one cephalometric measurement.

Unfortunately the mathematics for asymmetrical curves has not been as well refined or readily accepted as the mean and standard deviation. But this may change now that irregular curves such as cubic spline are being used in fields such as insurance, which deals with human phenomena.

Another example of current interest is the use of representative 'patients' or composites as Ricketts (see Overseas reports) calls them. Consider two treatments which may cause the mandibular symphysis to grow to the positions suggested in Figure 2(b) and Figure 2(c). Let us firstly analyse the responses graphically, before considering a numeric analysis. Where would you consider the representative responses to be? If the way-out response is taken into account in Figure 2(b) and deriving the average (means) by laboriously taking the average of each pair of tracings sequentially, one would have the representative somewhere near the dotted line. Alternatively, one could lay all the tracings over one

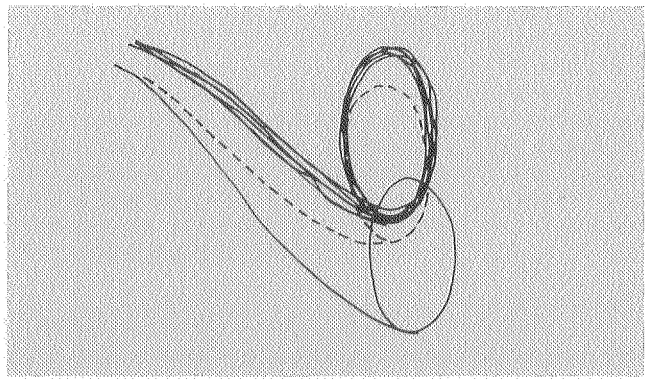


Figure 2(b). Illustration of hypothetical response of mandibular symphysis to treatment, with one unusual response.

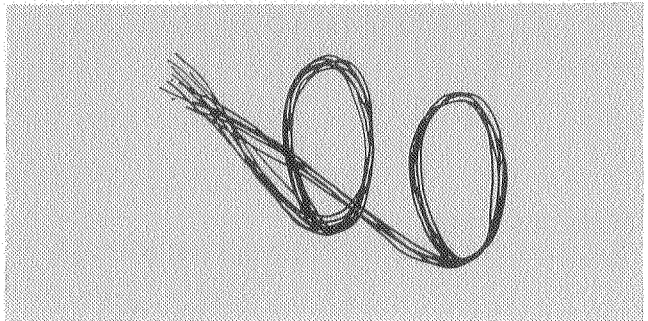


Figure 2(c). Illustration of hypothetical response of mandibular symphysis to treatment, with two groups of response, or bimodal.

another, correctly registered at cranial base, CC or whatever is your preference, on the X-ray viewer, and draw a representative tracing through the 'darkest' area of images. This would be a crude graphic means of establishing the most frequent response or mode.

The most useful information could come from a distribution such as Figure 2(c). Here we have two distinct responses, with two frequent occurrences, that is, a bimodal pattern. Such a pattern could be most significant in several ways. Let us imagine that you had devised a 'whizz bang' way of making mandibles grow... or at least you thought you had. So you tried it out on a sample of retrognathic individuals. But to your disappointment, the results showed that the mean change was not significantly better than one would expect from natural growth. But as you pondered the pattern of the distribution in graphic form you noted that there were two groupings or modes of response. Then you looked at the type of patient associated with each response. To your elation it turned out that the hypothetical treatment produced a significant change in the size of the mandible in the subgroup of the sample who had small mandibles, rather than in those patients who had normal sized mandibles set distally, as was the case with the majority of the sample. This conclusion is obvious graphically, but one would require not only sophisticated numeric analysis, but also good communication with one's statistician.

For acceptance by others, one would have to resort to 't' or 'F' tests (Moroney, 1962 :p236) to confirm a valid difference between the two responses. As an aside, it should not be too difficult to write a computer program to recognise a bimodal pattern.

In the next newsletter, attention will be given to another way of determining a typical case within a group, namely, weighted averages, which has exciting possibilities to help make decisions.

Delphi Process

In the last newsletter, it was promised that this term would be discussed in this issue. The Delphi Process is similar to a round table discussion, except that the panel

is not physically together and so communicates in writing. This is obviously suitable for Australia, due to the distances between centres. One of many topics which could be considered is writing the specifications for archwires. As users, clinicians are in a good position to determine what is required of an archwire for each stage of treatment. Having established that as a profession, the specifications could be rationalised and presented in the journal for materials scientists, metallurgists, manufacturers etc. to produce the desired product. Volunteers and nominations welcome.

Future issues

Since the newsletter is essentially an overview, it has only scratched the surface. In the future it is hoped to discuss decision theory and other areas of operations research, and develop other processes to complement the Delphi Process. Are we not fortunate that clinical orthodontics is so intellectually stimulating by requiring such a broad range of background disciplines?

Yours sincerely,

POSTSCRIPTS:

Suggested protocol for Abstracts & Reviews

1. Speak or write to Dr. Stanley Jacobs in the first instance to ascertain size, style etc. to prevent wasted effort.
2. Leave space at the top of the script to enter general comments for an introduction during or at the end of the review. This reduces the need for a second reading.
3. Scrutinise the sections of the publication. Plan to do a manageable section at a time.
4. It is not advisable to write extremely brief notes or headings only, as it is usually not possible to complete a review in one session. If one cannot get back to the reviewing within days or weeks, one may forget what the notes referred to, and one may need to start the review again.
5. When comments have been recorded on each segment, then produce a general introduction and conclusion. The conclusion should indicate whether the article is to be recommended and for whom.
6. Having completed this draft, two features need to be born in mind.

(a) Consider the legal aspects of a written review which will be widely read, and of defamation in particular. Naturally, editors will often provide some guidance, but as an indication, part of a directive from FAUSA will suffice here: 'A statement is defamatory, if, *inter alia*, it imputes to a person unfitness for, lack of qualifications for or incompetence in their trade, office or profession'... and '...It need not be a precise allegation of plagiarism; merely innuendo is sufficient.' For those requiring further reading, a new edition of Sawyer (1984) is available.

(b) The hardest part of the review is cutting the material down to the desired size, especially if detailed notes of each section have been taken.

7. It is good practice for all written material, and especially that which is to be widely read, to be completed in sufficient time to be able to lay it aside for some days, and then re-read it oneself. Those of us without perfect recall will have time to forget what we had in mind at the time of writing, and have the advantage of reading it with a fresh mind. Usually some part requires clearer expression.
8. For those readers who require a more formal study of the review, a suitable starting point is Part Two of Krampitz and Pavlovich, especially Chapter 20 headed 'The process of critiquing' by Komnenich and Noack (1981). In the full reviews given as assignments to students, each student should consider seeking qualitative

opinions at least, from senior colleagues as has been recommended in the last newsletter for their research projects. Abstracts of such reviews would be welcomed by the journal.

Negotiations are being carried out to have an article produced by a statistician for the journal so that we may all be instructed how to read the literature more intelligently.

9. Finally, before having any contribution to the journal typed, please check which typewriter type face is suitable. The reason for this request is that an Optical Character Reader may be used for input into the journal in the near future since much cheaper ones are becoming available. These devices allow typed material to be 'read' into a computer without retyping, and are thus quicker and more accurate.

Suggested protocol for Problem-solving

1. Documentation

- (a) The first, and one of the most important acts in complex problem-solving is to write down the problem in detail. In fact, it may be even more effective if the problem is posed in more than one way.
- (b) All relevant material, such as causes, variables, effects should also be written down, preferably in a schematic way (Sowa, 1984). Some problems lend themselves to lists and sublists in columns, whereupon arrows may indicate relationships and references (*Figure 1(b)*). More complex problems may be documented by Busan-style 'brain dumps', an enhanced form of which is *Figure 1(a)*. An useful adjunct is to precede every item with open brackets to allow numbering for indicating an order at a later stage. These are discussed in the body of the newsletter, as are most of the points. An erasable pencil allows easy modification of the schema.

2. Background information

This is most desirable. Sowa gives a most interesting example from Bransford and Johnson's study on page 131. Subjects were asked to read a passage, and were then tested for comprehension and recall. Those who were told what the topic of the passage was about beforehand were able to recall twice as much material.

- (a) The distinction between memory-by-rote and knowing was considered as far back as ancient times (Seneca, as quoted in Sowa, 1984). Constant exposure and familiarity with a topic means that one may have had time to mentally separate the procedure from the underlying principles, which is a good basis for analysing a problem. It may be prudent for orthodontic students to tackle smaller and quicker problems to learn the methodology, and to gain confidence. Hopefully, when problem-solving methods have been formalised and refined more than at present, problem-solving projects will be as common in orthodontic training programs as are research projects today.

(b) Much can be gleaned from consulting colleagues and other experts. This can be an active and a passive communication. That is, not only can one seek information, but one can also "bounce ideas off" colleagues.

(c) Once the problem has been defined, a dossier should be started. It is good practice to photocopy relevant information as one comes across it, and to place it in the file. A photocopy is more compact to place in a folder than a whole journal, and one can write comments on it.

3. Plan

(a) Following an evaluation of all the variables, a plan should be devised which is comprehensive, cost and time effective, and ethical. This is as important to problem-solving as a VTO is to treatment planning. An old proverb applies to both: 'Those who don't know where they are going will surely end up just there.'

(b) Larger and more complex problems may be broken into sub-problems. This is similar to the engineers' finite element analysis. This term means, for example, that a

structure is divided into a number (finite, not infinite) of components (elements) for analysis to determine which is the weak link (element) in the structure, rather than an overall or average test.

Providing there is good communication, it is not essential that the one person investigate every sub-problem or element. For example, a group of students or a Study Group could undertake to solve a complex problem, with the individuals working on it in a coordinated fashion.

4. Reflective phase

Whilst this heading is positioned here, it could justifiably be placed between every other heading. Nevertheless, the correct questions and answers to complex problems rarely come all at once when they are wanted. The last newsletter stressed the importance of asking the correct questions to lead to the correct solutions. Some questions may invoke lateral thinking, many pertinent questions are paradoxical.

5. Accuracy and limitations.

One should consider how accurate the records are in relation to the problem. Sometimes simple clinical records are sufficient. For other problems where small dimensions are involved and much hinges on their figures, one may need to use sophisticated Error Analysis as discussed by Houston (1983).

For some problems, one can use the opposite side of the mouth as a control, providing the situations are reversed in a predetermined random manner (Langley, 1979). This control method applies particularly for evaluating new bonding and luting agents.

6. Simulation

Other disciplines, such as engineering, are using computer simulations to great effect, as we see in several automobile advertisements on television. Some software has been written for cephalometric projections and archform, but at this point most are not sophisticated in the 'what if' realm, with the exception of that used for orthognathic surgery. Traditionally, dentists have used articulators for simulation, and we know their limitations (see Barnett, this issue).

7. Honesty

As suggested in the last newsletter, the Null Hypothesis is the quantitative research way of playing the Devil's advocate. However, to prove that the negative is wrong, does not always mean that the positive is correct. There may be other alternatives, so one should be thorough in searching out all alternatives in both research and problem-solving.

Qualitative research uses 'triangulation'. This means other methods are used to confirm the validity of the findings. Part of the plan should address the problem of bias, to satisfy oneself, at least.

8. Perseverence

Glaser and Strauss (1967) stress the dynamic nature of qualitative research. Problem-solving is not only dynamic in that one usually follows leads from initial findings or may even go off at tangents, but it may be quite common to go back to Point 1 to revise the original assessment, and start down the line again. One practical suggestion is to have 'scratch pads' readily available in the surgery area, so that if thoughts or observations occur, they may be written down and transferred to the dossier at a convenient time. For filing, a manila folder with the sides stapled or taped to prevent the pieces of paper falling out is sufficient.

If the deliberations about a problem become somewhat confusing, remember Geroch's comments on theories of physics. In fact, could one be so bold as to say that some transient confusion may mean that the subject under investigation has been considered thoroughly in depth and breadth?

"Opportunity for distinction lies in doing ordinary things extraordinarily well."

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