

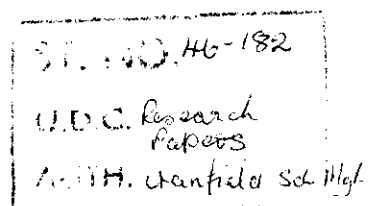


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AN INTRODUCTION TO MEDIA SCHEDULING -
APPROACHES AND PROBLEMS

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SECTION I OVERVIEW

This paper aims to provide an introduction to the various approaches which have been used in handling the problem of scheduling communication messages in competing media forms. The references included in the discussion are by no means exhaustive of the number of examples of applications of the different approaches. Instead, attention has been restricted to those studies which, either illustrate the basic principles of the individual approach, or suggest ways of overcoming the accompanying limitations.

A number of major conceptual or methodological difficulties associated with the media problem are felt to be sufficiently important to warrant individual consideration. Accordingly, separate sections are devoted to the problems of specifying the objective function, weighting factors and the time element within media scheduling.

SECTION II. INTRODUCTION

The media planning operation generally begins from the marketing brief, which will tell the planner a number of important points about the product to be 'promoted'. These may include regional strengths or weaknesses, in retailer and consumer terms, the nature of the product, the demographic characteristics of the target segment, purchasing regularity and seasonality, and finally and most important the media budget.

Having decided on the type of campaign that is going to be run, the media strategy, and the media objectives, the latter being essentially an interpretation of the marketing brief in media terms, the detailed media selection process begins first with the broad choice of media class. The evaluation of the various alternative media vehicles within a generic media class is the most scientific part of the media planner's task. It is this problem of selecting the most economical way of reaching the media objectives which will be discussed in detail in this section.

SECTION III THE MEDIA PLANNING PROBLEM

The media planning problem has been stated in many ways. Essentially, the media planner must select a number of vehicles - specific newspapers - journals etc. - to carry his ads over a predetermined period of time, and he must specify how many and which ads will be placed in each vehicle at each point in time the vehicle is available. He must do this within a prescribed total advertising budget and in a way that will 'effectively' expose some appropriate target audience to his advertising messages.¹

The majority of approaches to the media planning problem seek to optimise some variant or other of the total advertising impressions provided by a schedule for a given appropriation. Definitions of the problem vary according to the nature of the approach used, the variables included and the specification of the functions involved. To quote one of the leading authors,

"In essence, the complexity of the media problem has led to a variety of methods of solution depending on the assumptions made in each case" (Broadbent)²

For example advocates of the 'linear' programming approach to the media planning problem would favour the following problem statement of Day³:-

"Media selection problem is to allocate a scarce resource among a large number of alternatives so that the best possible contribution is made to a central objective. The objective to be maximised is the marketing effectiveness of the advertising programme, i.e. obtaining the maximum possible impact on the pertinent market target with a given budget".

Nevertheless differences in definition exist even within those advocating similar approaches. For example, Bass and Lonsdale⁴ in formulating their linear programming approach state the problem as one of selecting the best set from among various media alternatives where alternatives are taken to include not only media but specific choices within media. Whereas Day however, talks of maximising the 'marketing effectiveness', Bass and Lonsdale propose that the criterion for comparing alternative media schedules is taken to be 'exposure'. A further variant on the selection of the maximisation

criterion is provided by Aaker⁵ who argues that the aim of the media planning process is to determine within a given budget, that media insertion schedule which will obtain the greatest impact for an advertising campaign of given length.

Finally, at this stage, since a separate section is devoted to the treatment of maximisation criterion and objective functions, the definition afforded by Little and Lodish⁶ is important.

"Given a set of media options, a budget and various data about the media and the audience, which options should be used and when should they be used?"

Such a statement of the problem differs from those earlier mentioned in that it implicitly recognises the time element. The majority of media approaches to the media problem suffer in that they are static models apportioning the media budget to alternative media in order to maximise 'effectiveness' at some point in time.

Several authors have pointed out this failing -

"those media models which do not allow for the fact that people forget are clearly defective" (Lawrence⁷)

Similarly Brown⁸

"Any conceptual model of the media process must surely include the possibility of the decay of effect through time in the absence of reinforcement"

Probably the most comprehensive treatment of the media problem is that of Lee⁹ who from the outset goes beyond the usual media schedule assessment criteria of coverage and impact in considering those campaigns which are intended to generate and maintain 'a specific level of awareness' in a predetermined target population throughout a certain period.

This is not to suggest that work has not been carried out on the dynamic aspects of media response, merely that up until recently such treatments have been regarded as the prerogative of the advertising theorist and management scientist.

(Examples include the distributed lag models ¹⁰ , ¹¹ , Palda's treatment of the cumulative effects of advertising ¹² , Forrester's "industrial dynamics" ¹³ , Benjamin and Maitland ¹⁴ , and the classic studies of Kuehn ¹⁵ , Dorfman and Steiner ¹⁶ , Nerlove and Arrow ¹⁷ , and Vidale and Wolfe ¹⁸ ."

Such approaches have typically employed sales response as the 'objective function', i.e. whereby advertising or media communications is allocated or scheduled to maximise sales, or as the "response function", whereby different advertising or media policies are evaluated according to the sales generated. The logic behind these approaches being that the greater the sales, the more 'effective' the medium.)

In the field of media scheduling, objectives are not so far along the continuum as sales, media planners typically contenting themselves with exposures or opportunities to see. As an explanation rather than a justification for such a policy, a media man might argue that sales are affected by many influences in addition to media placement:- advertising copy, price, distribution, product quality etc. The practical difficulties of extracting the particular effects of media placement are both complex and costly ¹⁹ . The complexity stems, as noted by Shocker ²⁰ , from the large number of media alternatives available and the correspondingly larger number of feasible media schedules which can be constructed. In addition, from substantial discounts offered for multiple purchases of the same or related media vehicles and from interactions between media alternatives, which influence both the cost and effectiveness of different schedules. Finally, it stems from the interrelations between the problem of allocating the advertising media budget and that of determining the size of that budget, the nature of the advertising theme and copy and the appropriate measures of effectiveness of advertising exposures. While Gensch ²¹ adds that other

factors include the climate of the media vehicle, its prestige, the media qualities in relation to the requirements of the product message, and the environment in which the customer receives the impression.

Before moving on to consider in detail the approaches which attempt to deal with this complex problem, some definitions of terminology are felt to be in order. The following are those of Little and Lodish.²²

Firstly, media class - defined as the alternative types of general media available e.g. journals, newspapers etc.

Secondly, media vehicle - defined as the particular journal or newspaper.

Thirdly, media option - taken to be a purchasable unit e.g. a half page space in a media vehicle.

Fourthly, media insertion - one media option purchased and specified according to a time period.

Finally, media schedule - a collection of media insertions over a planning period.

Approaches to the Media Problem

The approaches fall into two categories as outlined by Broadbent.²³

The formula approach consists of models which take a mathematical optimizing approach having a high degree of structure in which the media data are reduced to comparatively few parameters and various simplifying assumptions are made in representing how vehicles actually reach people. But it is not known how drastic such assumptions are. Further, extension of such models by introducing competition and time into the problem formulation may prove difficult.

The second category is that of Individual Models which are non-optimizing. Generally such approaches make fewer simplifying assumptions with the result that it represents a more realistic formulation of the problem. Such approaches are less rigidly constrained but do not yield optimum results. The implication as pointed out by Kotler²⁴ is that a "near optimal solution to a rich statement of the problem is preferable to an optimal solution to a poor statement of the problem."

The underlying logic of this dichotomy of approaches to the media problem is worth restating by reference to the following succinct passage from Gensch²⁵: -

"The optimizing approaches all try to reduce the problem by using simplifying assumptions and then running the simplified system through a mathematical algorithm to find the best result. In contrast, the non-optimizing approaches attempt to deal with the real world system in all of its complexities. When simplifying assumptions are made, they are not necessitated by the need to conform to the constraints of a given mathematical algorithm. The emphasis is on the system, and through sensitivity testing, trying to ascertain how closely the model user's view of reality corresponds to the real world."

1. Optimizing Approaches - Linear Programming

The first model, linear programming seems like a natural format for analysing the media selection problem. It is applied to problems where there are a large number of ways to allocate scarce resources among competing alternatives in order to attain the best possible value of some stated criterion function subject to a number of limiting constraints. The media budget is the scarce resource and various journals, newspapers etc. represent alternative means of spending the budget allocation. The main constraints in media selection are the size of the media budget and the minimum and maximum usages of specific media vehicles and media options.

The best combination is determined by some effectiveness criterion, usually stating that the objective is to get the most weighted advertising units for a given budget or the least cost for a given level of weighted advertising units. The weighting in the criterion function is an attempt to have factors - such as the ad's target population, the difference in prestige of the various media vehicles, and the different exposure values of the various insertions in each - influence the decision of the linear programming model.

Models differ principally in the specification of the objective function. Probably the most widely used criterion of assessment in current media practice is that of "opportunities to see." In such cases, constraints are specified in accordance with basic data on the audience e.g. readership habits and the cost structures of the various media. Typically, schedules are then evaluated in terms of frequency and coverage criteria depending on the media policy specified for the product.

Probably the first publicised commercial application of the linear programming approach was the model proposed by BBDO.²⁶ The problem is stated as one of determining the media mix which would maximise the number of effective exposures subject to:

- (a) size of the total advertising budget
- (b) minimum and maximum usage rates for various media
- (c) specified exposure rates to different market segments.

Developments in linear programming models have been principally in
(27)
the refinement of the objective function. Kotler proposes to maximise
'effective exposures', the latter embodying a weighting to reflect
the media planners' preference to have the media message exposed to
certain predetermined segments of the audience. The effectiveness function
in this instance is written as

$$E = e_1 X_1 + e_2 X_2 + e_n X_n$$

where E represents the total exposure value of a media plan

e_i = exposure value of one ad. in medium i

x_i = number of ads. placed in medium i

this to be maximised subject to various budgetary and institutional
constraints.

(28)
Wilson adopts a similar approach by combining qualitative media
ratings with consumer profiles to derive rated exposure units which are
an estimate of the number of people who are both consumers of the product
and exposed to a media vehicle carrying an insertion. The objective
function then becomes that of maximising rated exposure units for a
given budget.

(29)
Again, Bass and Lonsdale develop the concept of weighted exposure units
to give greater weight to those insertions in media vehicles whose
audience distribution is similar to the market distribution of potential

customers. The authors do, however, reach some important conclusions on the applicability of the mathematical structure required by linear programming to the media problem -

"linear models are crude devices to attempt to apply to the media selection problem. The linearity assumption itself is the source of much difficulty. Justifying an assumption of linear response to advertising exposure on theoretical grounds would be difficult. The restraints are fundamental judgements about the non-linearity of response "

Kotler⁽³⁰⁾ has summarised five of the most important artificialities arising from the linear programming formulation which severely restrict the model's usefulness : -

1. Linear Programming assumes repeat exposures have the same effect.
2. It assumes constant media costs - no discounts.
3. It cannot handle the problem of audience duplication.
4. It says nothing about when ads should be scheduled.
5. It requires data which are often poor or non-existent.

Attempts have been made to suggest ways of approximating one or more of these problem areas so that linear programming models might provide more realistic results. Brown and Warshaw⁽³¹⁾ admit that the response to advertising inputs is nonlinear but suggest that it can be adequately represented by a number of linear relationships which can predict effectiveness per additional advertising input.

Although it is possible to make the objective function nonlinear, it is difficult to deal with the constraining equations nonlinearly and still use the simplex algorithm. The real problem is that many constraints, such as discounts, estimates of audience duplication, and value of repeat exposures, are either known or believed by media experts to be nonlinear

functions. To quote Gensch⁽³²⁾ -

"The problem is not that the linear programming model cannot deal with many constraints simultaneously, but rather that the model cannot handle the constraints nonlinearly."

One of the few approaches designed to treat explicitly the problem of duplicated audiences and the requirements of integer values for decision variables is the decision programming approach of Zangwill⁽³³⁾. The approach is an extension of linear programming which relies on introducing decision variables to reformulate the media selection alternatives into a set of mutually exclusive, collectively exhaustive variables. Thus, for example, selection of a specific media class and the corresponding number of media options purchased is taken as one alternative, thus allowing the exact cost to be used which includes all discounts and other charges. Similarly, dynamic factors are taken into account since inputs at different time intervals represent different media selection alternatives with correspondingly different rated effectiveness values.

Mathematical Heuristic Approaches

Heuristic programming is the application of a heuristic rule to a mathematical model in an ordered fashion⁽³⁴⁾. A heuristic rule is one that is useful in determining better solutions to a problem. Heuristic programming leads to good solutions, but it cannot guarantee that the optimal solution has been found.

Such approaches are represented mainly by the work of a number of British operational researchers who attempted to break away from constraints of the known optimizing algorithms which force unrealistic statements of the problem.

Lee and Burkhart⁽³⁵⁾ were the first authors to formulate mathematically the media problem in a meaningful fashion. They clearly differentiated between the exposure criteria of impact and coverage and developed mathematical relationships for them. In their first paper, the maximisation of the impact of the campaign was attempted by a heuristic rule of purchasing advertisements in an inverse proportion of the square of the cost per thousand. The maximisation of coverage was attempted under the assumption that the square of the proportion of the target group readership for a media divided by the cost for an insertion was equal for all media :

$$\frac{A_1^2}{C_1} = \frac{A_2^2}{C_2} = \dots = \frac{A_i^2}{C_i} \dots \dots \frac{A_n^2}{C_n}$$

where A_i = proportion of target group reading media i

C_i = cost of one insertion in media i.

Taylor⁽³⁶⁾ proposed a graphical, heuristic procedure to derive solutions to the problems Lee and Burkhart formulated. The procedure was based on first determining the optimum size of ads for each medium and then specifying the number of insertions. The criterion function is a combination of coverage and impact and represents a compromise between the two criteria. The magnitude of the compromise is specified by a managerial decision regarding the relative weights to be given to coverage and impact. The number of insertions is determined by a graphical procedure which attempts to determine the point where the marginal returns to the last insertion are equal to the cost of the insertion for each medium. The output of the procedure is the number of ads to place in each medium and the size of each insertion.

D.M. Ellis⁽³⁷⁾ modified Lee and Burkhart's problem formulation to include a more complete probabilistic response function by assuming different probabilities of exposure for different people in the target group. He also found a mathematical algorithm to solve the problem. This algorithm is based on a marginal response versus marginal cost calculation, where the marginal efficiency measure is a function of the log of the marginal response magnitude.

Lee's first model⁽³⁸⁾ was built for a static state and later expanded to take in dynamic effects. To evaluate media schedules, Lee selects coverage and impact defined as -

(1) coverage - the proportion of the population seeing at least one ad,

(2) impact as the average number of times an ad is seen.

The essence of the model is represented in the following basic equation -

$$R = Q \sum_r W_r I_r$$

where R is the response function indicating how "positively" the target population responds to given media schedule.

Q is a value indicating the effectiveness of the formats used.

W_r is a weighting factor measuring the proportionate response from those people who have received r impacts and who form a proportion I_r of the target population.

To derive the mathematical formulations which support this equation, Lee and his associates made a number of assumptions, the realism of which very much determines the quality of the approach (Gensch⁽³⁹⁾).

The first assumption states that the attention value of an advertising form is solely a function of its size, and is not affected by the use of colour, creativity or its position in the media vehicle.

Secondly, that the proportion of the target population who read both media M_i and M_j , say a_{ij} , is the product of the proportions a_i and a_j . This is to suggest that the likelihood of an individual reading a particular journal is independent of the nature of other journals which the individual reads.

The third assumption states that a person's probability of looking at the j^{th} issue of the i^{th} medium is independent of whether this person has seen the last ten issues of the given medium or has seen none of the last ten issues. Such an assumption denies the existence of reading patterns of given magazines over time.

Fourthly, the model assumes that people do not build recognition patterns in relation to ads. This would suggest that an individual is equally likely to recognise an ad irrespective of whether he has recognised it on five previous occasions or never before.

Assumption five states that sales are solely a function of the number of advertising exposures a person receives. Factors such as price, product quality and competitive activity are ignored.

Despite the restrictiveness of the approach in view of these unrealistic assumptions, the work represents an encouraging step toward a more scientific theory of advertising. In particular, Lee's⁽⁴⁰⁾ paper dealing with dynamic campaigns implicitly recognises that the readership growth curve is asymptotic and that a measure of the dispersion of the effectiveness of advertising over time is needed. The measure proposed is that of awareness which is characterised by recall of the advertisement.

Lee postulates a mathematical rule of forgetting in which the proportion of people who saw an insertion on day r and remember it on day d is hypothesised to be :

$$mq^{d-r}$$

where m and q are memory parameters.

Total awareness is defined to be proportional to total exposure. The total proportion of the readership of medium i who are aware of the insertion during d is :

$$Au_i(d) = \sum_{r=1}^d A_i mq^{d-r} (1-P_i) P_i^{r-1} Z_i$$

where A_i = proportion of target group reading medium i

P_i = probability of not reading insertion in medium i

Z_i = size of insertions in medium i

$Au_i(d)$ = awareness units associated with medium i on day d .

The criterion function is the total awareness on each day :

$$TAU(d) = \sum_{i=1}^n Au_i(d).$$

Lee formulated the problem as one of determining the schedule that will maintain at least a specified TAU for each day of the campaign at a minimum cost. The minimization may be done subject to constraints on the level of coverage and impact. Although Lee does not directly solve the problem, he suggests approaches that could be used to derive solutions.

Furthermore, the media model developed by Ellis⁽⁴¹⁾ is at least one example of a treatment of discounting. His model attacks the special case of the static, one period, media-selection problem. The cost discounts are included by examining a marginal exposure/cost ratio of each insertion. Ellis's algorithm does locate the best selection of media in the one period problem in the presence of cost discounts.

Unfortunately there are two aspects of Ellis's model that inhibit general application. To quote⁽⁴²⁾

"First, he has assumed the probability of readership to be independent in each media, so the duplication is merely the product of the probabilities of exposure to each of the two media. In addition to the limitations in considering duplication, the extension of his static model to the dynamic problem of media scheduling is infeasible. In the multi-period case, his algorithm would not be appropriate because of the expanding complexity produced by the combinational problems of media scheduling."

This series of papers by British authors was a comprehensive mathematical exploration of the problems surrounding media selection. They explicitly defined the criteria and the relationship among them. Although they did not explicitly link the criteria to profit, they indicated response relationships that could be used to do this. Their procedures were heuristic and led to good solutions, but in general they could not be termed optimal.⁽⁴³⁾

They have attempted to use basically linear models to deal with nonlinearities and discontinuities in the media selection problem. Their work indicates, as pointed out by Stasch⁽⁴⁴⁾, that a 'useful media selection model may result from modifying rather than abandoning the standard linear programming model'.

Dynamic Programming

The objective function of the dynamic programming problem is to maximise :

$$\sum_{i=1}^n R_i$$

where $R_i = f(s_i, d_i)$

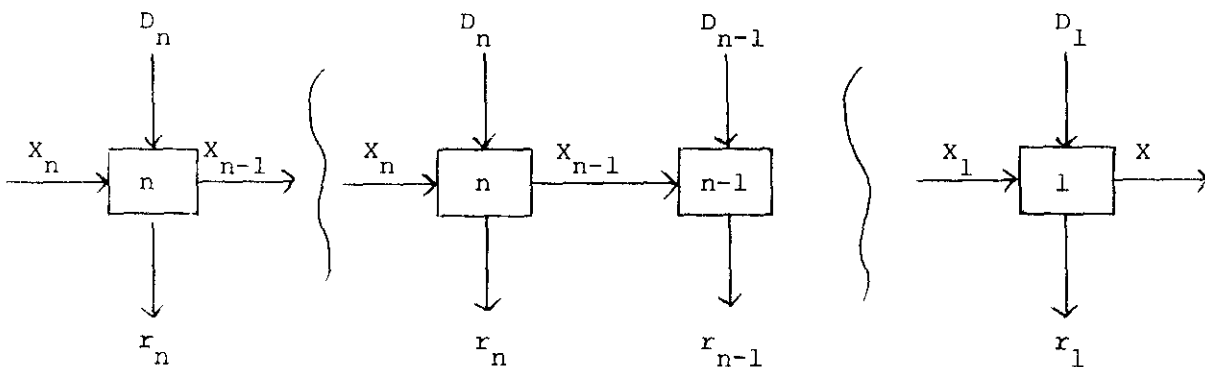
R_i is the reward of the process in stage i

s_i is the process state at stage i

d_i is the decision made at stage i .

The dynamic programming algorithm is a brute force technique that takes into account all possible combinations of decisions and then selects the best alternative. By selecting the best decision in the n^{th} stage and then working backwards to select the best decision in the $n-1$ stage, taking into account the decision made in the n^{th} stage, dynamic programming can reduce the number of possible combinations to be examined.

The essence of the approach is outlined in schematic form by Gensch ⁽⁴⁵⁾:



For the general stage $n(n=1,2 \dots N)$ of the N stage system :

D is the decisions made at each stage that controls the variables in the box.

X is the input for a stage that gives all relevant inputs to the box. The input for stage n is the output from stages $n-1$.

r is the reward for combining D_r decisions at stage n with X_n inputs.

Maffei⁽⁴⁶⁾ published a media allocation problem solved by dynamic programming. Keeping the problem small, he solves a problem that allocates a given advertising budget among three media in a test market.

Little and Lodish⁽⁴⁷⁾ considered a larger problem. The following description of the model is taken from Urban and Montgomery⁽⁴⁸⁾. Sales are taken as the criteria of assessment for proposed media schedules. The following expression defines sales as dependent on the number of people in each segment, their sales potential and the level of advertising exposure.

$$\text{Sales} = \sum_{i=1}^S \sum_{t=1}^T n_i p_{it} f(y_{it})$$

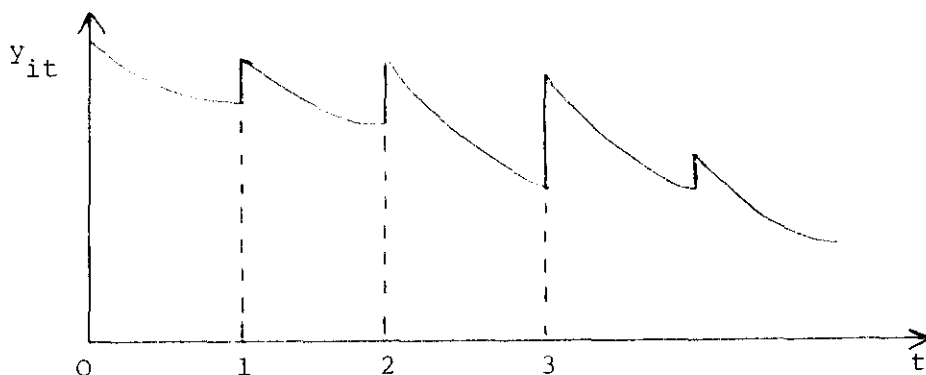
where n_i is the no. of people in segment i

p_{it} is the per capita sales potential of market segment i in period t

y_{it} is exposure value per capita in segment i during period t

$f(y_{it})$ is proportion of per capita sales potential that will be gained in segment i during time period t when the exposure value per capita is y_{it} .

The model is dynamic in specifying the following pattern for exposure value per capita over time (cf. Zielske).



The increase in the per capita exposure value y_{it} in segment i during time period t due to a schedule of media insertions is given by -

$$\text{Inc} = \sum_{j=1}^M e_j k_{ijt} x_{jt}$$

where Inc = increase in per capita exposure value in segment i during time t .

e_j = exposure value conveyed by one exposure in vehicle j .

x_{jt} = no. of insertions in media vehicle in time period t .

k_{ijt} = exposure efficiency in segment i of an insertion in media vehicle j during time period t .

In addition, the exposure efficiency factor k_{ijt} is the expected number of exposures per person produced in segment i by one insertion in media vehicle j at time t . The essence of the model is represented by the following expression which takes the exposure value at time t to be the exposure value at $t-1$ discounted for forgetting plus the added exposure value of the period t media schedule, i.e.

$$y_{it} = \alpha y_{i,t-1} + \sum_{j=1}^M e_j k_{ijt} x_{jt}$$

where α is the fraction of y_{it} retained from one period to the next.

The exposure value per capita is taken to be a principal determinant of sales and reflects the sales effects of a media schedule. The programming problem then becomes one of maximising the total sales subject to budget and media restrictions.

Nevertheless, the model is forced to make some questionable assumptions (49) the most important of which are the following :

1. Assumes that the number of market segments will each be homogeneous.
2. Assumes sales are solely a function of advertising exposures.
3. The model considers only one class of media.
4. Fails to handle the discounted cost structure of advertising media selection.

In spite of such restrictive assumptions, the model comes closest of all the approaches to solving the media problem. It considers accumulation of insertions and forgetting over time as well as intermedia replications in target group subsegments. The model's greatest advantage is its ability to comprehend the relevant media considerations and its explicit linking of exposures to the higher order goals of sales and profits.

CONCLUSIONS - OPTIMIZING APPROACHES

The use of the linear programming approach to solve the media selection problem may be regarded as perfectly adequate. The technique itself successfully handles the media problem but only in so far as the problem is realistically formulated. The major criterion of the validity of the linear programming lies in the restrictiveness of the assumptions and the consequent unrealistic nature of the selection problem.

Firstly, it assumes that the measure of effectiveness will be total exposure, a criterion the value of which is examined in a later section dealing with the objective function.

Secondly, it assumes that responses to media insertions are constant, i.e. that the tenth exposure to a respondent has the same effect as the first. Again, this assumption is examined in the section looking at the response function.

Thirdly, that there are no intermedia interaction effects. Such an assumption suggests that an individual who is exposed to a message in one medium is not affected by exposures he has received in any other medium.

Fourthly, that the costs of media insertions are constant. This phenomenon has remained a thorn in the side of all media model builders, and to date the discount structure has not been incorporated in any comprehensive media scheduling model.

Finally, the number of insertions is a continuous variable thus permitting solutions specifying fractional insertions. This problem can be theoretically overcome by integer programming. However, Urban and Montgomery⁽⁵⁰⁾ note that the computational effectiveness of these algorithms is generally poor and that it is not feasible at present to consider the use of integer programming for most media problems.

Goal programming is a further extension to the linear programming approach aimed at overcoming the above limitations. While it does not assume that there are no intermedia interaction effects its method of considering duplication is that the joint frequency of a reader's exposure value to two media is the product of the frequency function of the two media. Unfortunately, there is little empirical support in the behavioural field for such a convenient mathematical treatment. Furthermore, having conveniently found a way, albeit not entirely satisfactory, of handling duplication effects, the approach allows non-integer values for insertions.

An attempt to handle the assumption of a constant response to media insertions is represented by the piecewise-linear programming approach. This approach rests on the assumption that if the response to media insertions is not linear it must still exhibit a form of diminishing returns. Only, if the response function remains concave (i.e. no increasing returns) can the nonlinearity be approximated by an equivalent linear form. The approach, in removing this assumption, can no longer guarantee that the global optimum has been found and its problem remains the same as that of the iterative approaches, i.e. that if the response surface is not concave the approach may stop when only a local optimum has been derived.

Thus, it would seem that the basic linear programming format frustrates further attempts at improvement since as one restriction is removed by a variant of the programming approach, another restriction emerges.

Probably the greatest disadvantage of the linear programming approach is its inability to comprehend the dynamic and cumulative effects of forgetting and intermedia replication. Here at least the mathematical programming approach of Little and Lodish⁽⁵¹⁾ would seem to go furthest in suggesting a satisfactory treatment. Its limitations, namely that the heuristic employed does not guarantee an optimal solution and its inability to consider explicitly the duplication of media within subsegments, have been tested empirically and been found not to be severe. The greatest advantages of the approach are its ability to handle the time element and its explicit linking of exposure to higher order goals of sales and profits.

ITERATION MODELS

Iteration Models can be defined as follows : - ⁽⁵²⁾

"The underlying concept of the approach is to try to bring one media vehicle into the solution at a time. The vehicle with the highest 'value' is selected first. The list of available media vehicles is then reexamined, and the vehicle with the next highest 'value' is selected. This process is then repeated until enough media vehicles have been selected to exhaust the budget."

Such an approach has alternative names. The model developed by Young and Rubicam, details of which are reported elsewhere ^{(53), (54)}, is termed High Assay, and the essence of the approach is defined by Kotler ⁽⁵⁵⁾:

"The basic idea is to start with the media available in the first week and select the single 'best' buy. After this selection is made, all the remaining media choices are re-evaluated to take into account audience duplication and potential media discounts. Then a second selection is made for the same week if the achieved exposure rate for the week is below the optimal rate. This continues until the 'optimal exposure rate' for the week is reached at which point new media choices are considered for the following week."

Another name for this group of models is marginal or incremental analysis models which represent merely a variant of the economic criteria of marginal cost and marginal revenue, the logic being to select various media vehicles in order to equalise the net marginal contribution of each toward a criterion, e.g. exposures. The approach is based on a sequential rather than a simultaneous media selection process. It is an optimum seeking technique although it will not always lead to a global optimum, especially when the surface is characterised by several local optima ⁽⁵⁶⁾. Broadbent ⁽⁵⁷⁾ identified the problem in his review of media planning and computers. In his terminology :

"The obvious analogy for this method is with a man who tries to reach the highest peak in a mountain range by taking each of his steps in the direction with the locally steepest upward slope. This vivid representation also reveals the flaw possible in the approach : what if there is a valley between the highest peak and where the man now stands? The straightforward method will not be farsighted enough to send the man down into the valley because of the greater height he will ultimately reach. In other words, this method may only produce a local optimum."

A second disadvantage of the approach is that because the incremental approach chooses sequentially, it must keep all its earlier choices even though they may not appear optimal later. All other things equal the incremental approach will tend to include media options which have high gains in effectiveness on the first insertions⁽⁵⁸⁾. It will bias against media options with lower relative effectiveness in early insertions but which, because of accumulation and minimal duplication of audience, exhibit increasing returns or less rapidly diminishing returns later. This constraint imposed by past actions is an inherent limitation imposed by the incremental heuristic.

Heuristic approaches to the media planning problem differ principally in their methods of determining a measure of effectiveness for any feasible media schedule, but they rely upon one or more heuristic to search the set of feasible media schedules to find a nearly optimal one. The heuristics aid in searching through this set so that the number of schedules to be evaluated is quite small relative to the total, yet the likelihood remains high that a good schedule will be identified⁽⁵⁹⁾.

In addition, the incremental method has the advantage that search can start from any feasible solution rather than from a restricted set of such solutions, for example, the basic, feasible solutions required by the simplex algorithm of the linear programming approach.

Models using the iteration approach have five basic limitations⁽⁶⁰⁾:

- (1) It does not always yield an optimal solution.
- (2) The model does not specify the timing of the advertising.
- (3) The criterion function is too limited for a general model.
- (4) The model does not use integrated media class data.
- (5) It does not take into account the effect of advertising from past periods.

To recap briefly, by way of an example, Brown⁽⁶¹⁾, in his model, proposes that a media schedule be constructed sequentially by choosing at each stage one purchase of the media option which provides the greatest increment in schedule effectiveness per dollar cost. The selection algorithm is defined as the marginal cost efficiency of a specified magazine, where this is taken to be the amount by which the selection of an additional issue of magazine *i* would increase the schedule's weighted score divided by the cost per insertion in magazine *i*. Media options whose availabilities have been reached are then removed from the list and are not available for future selection. This procedure continues until either the advertising budget is exhausted, all media option availabilities are exceeded, or some other stopping constraint is reached.

A second example, developed in the UK, is the Meteor⁽⁶²⁾ model currently available from Computer Projects Ltd. and based on the formula first proposed by Metherringham⁽⁶³⁾ for approximating the coverage of a schedule, given the duplication between each pair of publications in the schedule and the duplication between successive insertions in the same publication.

In operation the model first of all assigns market weights to each individual, these then being summed for all individuals to get a weighted population. In addition to this, the weighted readership of each publication is found by adding the market weights of each of its readers. This readership is then multiplied by the media weight to give the readership value used in the model.

Dividing the weighted readership by the cost of insertion in a given medium gives the 'impact value'. The computer then ranks all the media under consideration in ascending order of cost effectiveness, and prints this out as a table.

The program then proceeds to build the schedule step-wise, i.e. insertions are added one by one so as to produce the greatest gain in impact per £ of the insertion cost. The impact for the first step is simply the weighted readership of the first publication chosen multiplied by the response weight for one exposure. To add the second insertion the program has to evaluate what would happen if one insertion in each publication separately, including the one already chosen, were to be added. The weighted readerships having one and two opportunities to see are counted; the response weights are multiplied up and the cost of this particular insertion added to the cost of the first insertion. This process has to be repeated until the media budget has been reached and the program stops.

In addition to the five limitations of the iteration approach outlined earlier, Shocker⁽⁶⁴⁾ notes that ability of the heuristic to find an optimal schedule is further frustrated by the media discount consideration :

"The incremental search heuristic considers any media option for inclusion in the schedule as long as it increases the effectiveness of the schedule, and it chooses among alternatives on the basis of the incremental effectiveness per dollar of cost afforded by an additional purchase of each. Media discounts affect these incremental effectiveness-cost ratios and make them behave erratically with increasing purchases of a given media option."

Of the more recent iteration approaches, Little and Lodish⁽⁶⁵⁾ and Aaker⁽⁶⁶⁾ are among the few who have recognised the major limitation to the approach stemming from the possibility that several local optima may exist in the 'effectiveness surface'. In addressing

themselves to this problem, they propose supplemental heuristics to improve the search. Aaker's heuristic requires the trial removal of a purchase of the least cost-effective media option at each stage and a comparison of the resulting cost-effectiveness decrement with the increment from another purchase of the medium most recently added. If the increment is greater than the decrement, media options are substituted. Little and Lodish⁽⁶⁷⁾ offer a similar heuristic that operates only on the final schedule reached by the basic heuristic, rather than at each successive stage of schedule formulation, allowing limited reconsideration of earlier decisions to improve search.

The directions of research aimed at improving heuristic search have been noted among others by Shocker⁽⁶⁸⁾, who sees one development being in the direction of 'look ahead' heuristics : i.e. those capable of exploring more than one purchase beyond the present stage or across the valleys separating local optima, as the Little and Lodish and Aaker supplemental heuristics do. A second development lies in the 'bump and shift' heuristic proposed by Kuehn and Hamburger⁽⁶⁹⁾ which seeks to modify the solution reached by incremental procedures alone. A further direction lies in the development of mixed mode models. These might use mathematical programming or other optimization techniques to find good solutions and heuristic methods in an attempt to improve them. Walker⁽⁷⁰⁾, for example, used a modified version of the simplex method of linear programming to find a local optimum and then uses heuristic rules to force an investigation of nearby extreme points in an attempt to improve it.

Simulation Models

The essential difference between optimization and simulation approaches is that while optimization creates a schedule from a candidate list, simulation assesses the value of a given schedule, usually in comparison with other alternative schedules. Simulation generally means that a panel of individuals is taken as being representative of the target population for advertising. Schedules are then tested for their effect on this theoretical group of people to determine their 'effect', however defined⁽⁷¹⁾. In this way many more factors can be taken into account outside the framework of the model.

The mechanics of constructing a media simulation model will not be dealt with here. For a first rate treatment, see Friedmar.⁽⁷²⁾

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The major limitations are :

- (1) The method does not include an overall effectiveness function. Instead it yields a multidimensional picture of impact.
- (2) The method lacks a procedure for finding better schedules.
- (3) The representativeness of the hypothetical sample population is always suspect.

Probably the most comprehensive attempt at defining a representative sample for the simulation process is that of the Simulmatics Corporation⁽⁷⁴⁾. The model consists of a sample universe of 2,944 make-believe media users representing a cross section of the American population by sex, age, type of community, employment status and education. Each individual's media choices are determined probabilistically as a function of his social-economic characteristics and location in one of 98 American communities. As the simulation of the year's schedule progresses, the number and types of people being exposed are recorded. The output of the simulation is thus a summation of the exposure

experienced by each of the 2944 microunits. The results of a campaign are assessed in terms of the cumulative reach over time, the frequency of exposure over time, the total exposure, audience profile and the costs for each of these results.

Broadbent points out two further aspects of importance⁽⁷⁵⁾. Firstly, since some of the data required are not known, mathematical methods were used to construct a data bank, based on reasonable assumptions. Secondly, the approach is purely descriptive and stops short at media exposure.

A very real restriction on the commercial utilization of such an approach is the cost of building the model and of constantly updating the inputs. In this instance, while the agencies who commissioned the research felt that continuing national samples were necessary to ensure the representativeness of the sample population, the cost of maintaining such a sample was more than they were willing to pay.

In the U.K., with a more concise, less fragmented media information system than in the States for example, many of the practical restrictions on the use of simulation approaches, such as the prohibitive costs to an individual company or agency of setting up and updating the essential media data, have been greatly eased with the increased usage of computer storing and processing facilities. We have at present, in this country, in any six month period approximately 15,000 individual records showing the frequency of reading of the respondent of nearly 90 publications.

With one or two exceptions, for example, the Build Schedule construction model⁽⁷⁶⁾ developed by Stevens of ICI which works on a subsample of 1,000 individuals from the 30,000 available on the NRS tape and employs monte carlo techniques based on these readership figures, the primary use of the media exposure data has tended to be of a "quasi-simulation" nature; that is, models are developed using a variety of methods and assessed

by using the data inputs from this media exposure data bank, to simulate the operation of the derived media schedules (See for example, the Dynamo model⁽⁷⁷⁾.) The procedure is very similar to the approach outlined by Young⁽⁷⁸⁾ (see later) where a media model is constructed using optimizing techniques, then simulated on the media exposure data test bed, and then subjected to further improvements before resubmitting to the 'simulation'. In this way the simulation is a form of assessment employed to discover the optimal schedule from amongst those constructed. (see also Media Research Group⁽⁷⁹⁾ - Media Model Comparisons)

A french model which differs from many others in its attempt to introduce time into the assessment is the Simulation des Comportements Ale'toriques de Lecture (- Simulation of Stochastic Reading Habits) and is the work of Marc⁽⁸⁰⁾. The model goes as far as issue exposure in providing a basis of assessment. Individual's reading over a period of time is given by a simulation based on a model of individual behaviour by Monte Carlo process. In addition it uses panel data as a check on the hypothesis underlying the model construction and the claims made on reading habits.

A second French assessment method, Media Planex is the work of Steinberg and Agostin⁽⁸¹⁾. It uses multi-media data (press, radio, cinema and in so doing recognises the problems of constructing a scale of equivalence see later - response functions). The model employs a weighting of both audience and messages. In addition it provides a response function which relates the number of exposures per individual to the "percentage penetration", defined as the percentage of population who recall the message. This is then used to weight the 'contact' distribution produced by a monte carlo simulation, to yield a single figure for the effectiveness of the schedule which facilitates a comparison of several schedules according to their effectiveness ratings.

The major contribution in this area in the U.K. has been the Computer Assessment Media Model of the London Press Exchange⁽⁸²⁾. It uses data from more than one media class by means of a technique dubbed the 'marriage' process. The result means that the model can compare, in this case, press and television schedules or combinations of both.

Essentially it builds on a number of basic weightings. Firstly, for each media vehicle, a weight defined as selectivity is taken to be a measure of the value of an advertisement in that particular vehicle over and above its readership profile, attention value or cost. For example, the same ad. may have more prestige and influence when it appears in one publication than in another. Secondly, a perception weighting which is a statement of the probability that readers/viewers will open their eyes in front of an advertisement. A third series of weights called impact weights are then used to determine the ad's usefulness, its effect on a person seeing it.

A single dimension used to describe how much advertising is received by an individual is called the campaigns impression value. For each individual, his probability of receiving an impression is computed from the three weightings above. By treating each panel member in turn the effect of the media schedule on that individual can be shown in terms of a frequency distribution of impressions. Summing over all individuals a similar distribution is obtained for the whole panel which by assumption is that for the target population. All that remains is to multiply this distribution by a response function which ranks impressions on individuals in terms of their importance, and a single figure is obtained defined as the effectiveness of the schedule. This effectiveness figure is the criterion used for choosing between schedules. Also, it is used to compare different additions to and deletions from the schedules. Each change is evaluated by its marginal rate of return, i.e. the change in effectiveness divided by the change in cost.

Reaction to the model has been generally favourable: Gensch⁽⁸³⁾

"the approach taken by the model of trying to combine all judgments involved in evaluating a media package into a logical flow sequence is a major step in the right direction".

Similarly, Jones⁽⁸⁴⁾

"CAM undoubtedly looks much more deeply into the problems of media selection."

There are two major criticisms of the model. Firstly, the initial reading and viewing data generated by the marriage process are poor. The second major criticism is that the model's entire output is in terms of one number, the difficulties associated with which are ably pointed out by Jones:-⁽⁸⁵⁾

"The main broad criticism is that CAM gives a measure of effectiveness, but in what terms? The media planner is suddenly thrust from circumstances in which he uses rather limited but understandable measurements of effectiveness into a new 'space age' dimension which he cannot relate in any way to the traditional measurements."

A second simulation approach which uses data from more than one media class is the result of work by Young.⁽⁸⁶⁾ The events being simulated in his model are the exposure or nonexposure of each individual in the population to each use of each media vehicle in a schedule. As it occurs each individual's exposure or nonexposure is recorded and finally summaries of reach and frequency of exposure can be produced for any prescribed group of individuals. But his approach is restricted to reach and frequency measurements only. The approach is similar to studies outlined earlier viz. a sample of 3,892 adults broken down according to sex, age group, education, income category etc. and individual's media exposure probabilities are assigned using Monte Carlo techniques. The interesting feature of the approach is that a second selection model is used to generate a set of optimal solutions which are then assessed in terms of reach and frequency by running the schedules through the simulation model. In practice, the simulation model simulates last year's plans before the media planner attempts to set down goals and specifications for the selection model to generate new 'optimal' plans. The usual sequence is to run the simulation model, then the selection model and then the simulation again.

The final model to be discussed is again one considering more than one media class. It is the Ad-Me-Sim approach of Gensch⁽⁸⁷⁾. The model falls into three stages. A data generation stage which uses basic viewing and reader habits to derive predicted probability values which are then converted into a reading and viewing pattern using a Monte Carlo system.

The second stage weights the population according to the extent to which the advertiser wishes to reach them. The third stage is the media evaluation stage which uses the data inputs and a number of additional judgment inputs to evaluate the proposed media schedules.

In effect, the individual's reading and viewing exposures are adjusted to take into account the effects of the individual's target weight, the ad. form weights, frequency weights and the media appropriateness weights. The interaction of the basic vehicle exposure data with the judgment factors previously listed is quantified and reported in the form of both static and cumulative reach and frequency figures and finally in the form of abstract impact units.

In addition to using the model to evaluate and rank proposed media schedules, Gensch suggests how alternative media schedules may be generated using heuristic programming applied to the experienced judgments. This is essentially a sequential step building approach identical to those outlined earlier.

In summary, simulation models are basically descriptive models, with the major emphasis on describing and replicating the real world. Once a model is considered to adequately describe reality, it can be made normative by the addition of heuristic rules. The normal procedure for testing the model's descriptive adequacy is first to have the internal logic structure approved by experts in the problem area, and second to run historical data through the model and compare the historical outputs with the model's outputs.

CONCLUSIONS - NON OPTIMIZING APPROACHES

The iterative and simulation approaches have the distinct advantage that a richer specification of the media scheduling problem is possible. In the eyes of the media practitioner this endearing quality is likely to outweigh its major deficiency, namely that it does not guarantee an optimal solution. Further criticisms of the assessment models e.g. that there is no linking of exposure to higher order communication goals, the inability to handle media discount structure and the dynamic, cumulative effects of advertising remain equally applicable to the mathematical optimizing approaches.

A further advantage of the iteration approach is that it can start from any feasible solution rather than from the restricted set of feasible solutions imposed in the programming approach. As a result of the sequential construction of the schedule, a planner may well be able to determine within narrow limits, the stage at which further additions to the schedule become 'uneconomic'. In the basic programming approaches, the alternative is to determine the exposures per pound of the media budget for varying budget allocations. While this sequential nature of constructing schedules may result, because of its having to retain all its earlier choices of media, in only a local optima, subsequent comparisons of such schedules with those derived from optimizing approaches have found an encouraging degree of similarity between the schedules selected.

In any event, one may argue that a satisficing approach to a well formulated problem within which the media planner can detect a healthy note of realism, is preferable to an optimal solution to a theoretical abstraction.

The simulation approach probably represents the antipathy of the linear programming format in its being free of restrictive constraints, and with the increasing advent of computerized simulation models it is becoming more and more possible to construct a computerized population on which to assess media schedules. Clearly, the introduction of varying functions for cumulative and decay rates and the manipulation of values for the different weighting factors can be more easily carried

out within the more flexible realms of simulation.

In terms of comparing the merits of optimizing vis a vis non-optimising methods of selecting media schedules. The current trend away from the optimizing approaches, may well reflect the general preference. As Gensch⁽⁸⁸⁾ points out,

" the models now most valuable to the decision maker are those that attempt to diagram the decision process and explicitly state the axioms that must be tested rather than those that attempt to abstract and simplify a decision process not clearly understood nor defined."

The foregoing section has attempted to identify the major approaches that might be used to construct and evaluate the feasible combinations of media vehicles available for a given product message. The review is by no means exhaustive. References included have been those which have either illustrated the basic approach or suggested improvements to it.

The subsequent sections examine some of the considerations which represent the major difficulties in the scheduling area, namely,

- the specification of a valid criterion worthy of maximization
- the problem of linking advertising pressure to an observable response.
- the dynamic effects of media placement.

Before moving on to these matters, brief consideration must be given to the scheduling of advertising messages within the television area. It is felt that to present in detail, some of these approaches, would add little to the foregoing discussion, and would only involve unnecessary duplication. Consequently, the similarity between the areas of print and television scheduling is mentioned and the need for an integrated media approach emphasized.

Scheduling within television media - a brief comment

The problems of scheduling insertions or exposures in television media remain essentially the same and the approaches derived in the print media field are clearly applicable. One of the most prolific writers in the entire media field, namely Adams⁽⁸⁹⁾ observed that the biggest dividing factor between choice of media, in this case, print vis a vis television media, was the type of product. A second, only slightly less important, determinant of the broad media to be used was found to be the size of the appropriation of the media budget. It is worth restating the author's broad conclusion, namely,

"many low ticket, high frequency of purchase, goods are identified almost entirely with television, whereas, many high ticket, low frequency of purchase, goods are identified very largely with the press."

Thus, while the problems of scheduling insertions either within press or television media seem to invite the development, if not always the application, of fairly sophisticated scheduling techniques, the problems of allocating exposures between differing competing media classes in a combined campaign still appear to be no nearer resolution. Indeed, apart from the early Beale, Broadbent and Hughes⁽⁹⁰⁾ work which derived a method for evaluating an integrated press and television campaign, no other authors have gone beyond the mere recognition of the problems of comparing inter media efficacy by weighting solutions. Further, the difficulties of determining a response function for a combined campaign implicitly treating the dynamic and synergistic effects still remain dark and stagnant in the unexplored depths of media research.

An example of the application of an optimized press schedule to develop optimized television schedules has been carried out by Adams⁽⁹¹⁾ and the problems and difficulties are ably handled in the original article.

The similarity between these two media areas, i.e. television and print advertising is further stressed when the development in the provision of media data is examined. Firstly, there existed a situation in both areas where media information was provided on an independent, commercial basis with the National Readership Survey in the print media having as its counterpart, Audits of Great Britain Ltd., in the television field. Since then, joint industry committees have been set up, i.e. JICTAR, JICNAR, with the aim of standardizing and improving the data situation. In addition to AGB's role within JICTAR for collecting and processing media data, they still operate a panel service financed primarily by the television contractors. In this content, they publish a large amount of information, under the name of the Television Consumer Audit, to advertisers who qualify by placing specified amounts of advertising on television and obtain the information free.

The differences in the two media situations are essentially the basic differences inherent in the nature of the media itself, rather than from any differences of approaches to the problem. The obvious differences between the two media classes are those of selectivity, duplication and the variance in the television media of the nature of spots from one to the next. However, to stress the element of divergence between the two media areas would be to ignore the considerable time and effort savings in deriving scheduling approaches clearly available from a recognition of the degree of overlap. This element of comparability is ably pointed out by the derivation of parallel indices for schedule assessment developed by Beale, Broadbent and Hughes⁽⁹²⁾, stemming from their encouraging attempt at deriving a 'married' data bank of media information.

The puritannical reader is referred to the excellent article by Barnett and Lougher⁽⁹³⁾ who have succeeded in deriving a television media model, MULTIPLUS, solely for television planning and evaluation.

In conclusion, it is felt that a more fruitful line of investigation lies in the development of integrated media approaches which deal with the problems of scheduling a combined communications campaign in more than one media class, rather than seeking to pursue an idealization of scheduling perfection within a single media class be it television or print.

SECTION IV The Objective Function - A Criterion worth maximizing

The link between media planning theory and classic advertising studies is probably closest in the area of the objective function. In simple terms, the central problem of any communication policy is to establish a criterion by which the effectiveness of different media or advertising campaigns may be assessed. Only when such a criterion has been established, can any form of investigation as to the effects of the communication begin. The response function aims to link the efficacy of various media or advertising inputs to an observable objective such as the level of sales, exposure opportunities or weighted impact units.

The concept of the hierarchy of objectives spectrum neatly serves to point out the difference in the selection of communication objectives employed by media and advertising theorists and practitioners. In general, much effort in the advertising area has been directed at establishing a link between advertising inputs and sales, the latter typically being assumed to be determined by the former. Media theorists, for the most part, have however, tended to content themselves with the other end of the objectives continuum, focusing on awareness and attempting to either derive or assess media schedules in terms of the exposures, measured in reach and frequency terms, per pound of the media budget.

While differences may exist between advertising and media researchers, the need to specify an objective function, irrespective of its particular identity, does seem to represent a point of agreement. For example:

Broadbent⁽⁹⁴⁾ "Such a criterion is difficult to find. Many familiar problems of advertising effectiveness, of inter media comparisons, of cover versus frequency + are contained in the search for a criterion. But a definition of effectiveness must be given before one schedule can even be compared with another."

Restatements of the problem of specifying the objective of a media plan abound, but few offer directional guidance: - e.g. Jones⁽⁹⁵⁾

"The objective of a media plan is to reach users or potential users of an advertiser's product in the most economical way in order that the advertisers' long run profits can be maximized."

Using the profit criterion poses many difficulties. First the media insertions must be linked to sales results. But, the sales results of the campaign are caused by a number of complex factors. The sales response to each medium is likely to change in a nonlinear manner as the number of insertions increases. This nonlinearity will be compounded by the carry-over effects in past insertions. In addition to replication over time, duplication between media in a given time period will affect the response relationships, as will the tendency for target group members to forget insertions with the passage of time. Even further complexity is introduced because the sales response to media insertions may be different for subsegments of the target group.

The situation is not helped by the present state of media research which encourages the planner to ignore the individual and the exposures that he receives, tending to consider average exposures on the target audience as a group, thus ignoring from the outset any hope of moving toward the ideal⁽⁹⁶⁾

Contrary to the profit criterion, exposure criteria are relatively easy to measure but are removed from sales and profit results.

Reach and frequency are possible exposure criteria, but each has different market implications. As Lee⁽⁹⁷⁾ has shown they cannot be maximized simultaneously by one campaign. Reach tends to assume that everyone receives at least one message, whereas frequency is concerned with generating the greatest number of exposures for each person in the target group. In this context, Young⁽⁹⁸⁾ seeks to justify the widespread use of reach and frequency as exposure criteria.

"In the absence of precise measures for many aspects of media planning, the media analyst has focused his quantitative analyses on the two things for which he can at least partially obtain objective estimates - how many people are exposed, and how often they are exposed."

Instead of being concerned with reach and frequency, media could be selected in order to maximize total exposure. In this case the reach and frequency are replaced by an overall criterion, which reflects the total exposure potential.

In summary, the three principal exposure criteria that have been proposed are total exposures, frequency (impact) and reach (coverage). The following definitions are taken from Urban and Montgomery⁽⁹⁹⁾

The total exposure is the sum total of the number of times any advertisement relating to the product is seen or heard by target group members in a given period.

The frequency or impact is the average number of advertisements for the product seen by each member of the target group during the given period.

The reach or coverage is defined as the total number of people exposed to at least one advertisement relating to the product in a given time period. The three subcategories of reach can be defined as cumulative audience, net coverage and combined coverage where cumulative audience is the reach of two or more issues of a given medium, net coverage is the reach of a combination of single issues of two or more media, and combined coverage is the reach of two or more issues of two or more media.

In addition, reach is often used in a more general sense, and is taken to be the number of different people in the target group or target group subsequents who are exposed one or more times to a given set of insertions.

Many of the media approaches described in the previous section favour the use of exposures or some variant thereof as the criterion. For example, Wilson proposes rated exposure units as the objective function,⁽¹⁰⁰⁾ the

objective then being to maximize rated exposure units for a given budget, or minimize cost for a desired level of rated exposure units. Similarly, Day⁽¹⁰¹⁾ is content to take exposures to a target consumer as the objective function. Many approaches, Brown and Warshaw,⁽¹⁰²⁾ Bass and Lonsdale⁽¹⁰³⁾ rank either media or individuals in terms of some weighted exposure unit factor as an effectiveness rating according to how closely the media profile matches the target audience profile. Zangwill⁽¹⁰⁴⁾ uses rated effectiveness units where effectiveness is taken as the number of expected exposures weighted by various factors thought to influence sales.

Of the non-optimizing approaches Brown⁽¹⁰⁵⁾ goes a long way in refining the basic exposure unit. Firstly, a respondent is assigned a media vehicle weight which is a compounding of his probability of reading the vehicle, the probability of his being exposed given that he reads the issue of the vehicle containing the ad, and an entirely subjective exposure effectiveness rating. In addition, a discount factor is employed to represent decreasing effectiveness of successive exposures (a decreasing returns response function). The objective function is then to maximize the weighted discounted exposure effectiveness for each target member for all those media vehicles in the schedule for which the individual is taken to be a recipient. (see Original). Aaker⁽¹⁰⁶⁾ represents another heuristic approach where potential exposures to be added according to marginal contributions, are rated according to a number of dimensions which include weighting factors to reflect a respondent's membership of the target audience, the degree to which a media vehicle is appropriate in terms of editorial content, and the number of previous exposures to the individual.

While the approach offered by Little and Lodish⁽¹⁰⁷⁾ states the problem as being one of maximizing the total sales over the planning period subject to budget and media restrictions, the treatment of exposures is the essential part of the problem formulation. A schedule of media insertions are assessed according to the corresponding increase in exposure value over time where this is taken to be a function of the exposure value conveyed by one insertion, the number of insertions and an expression termed the exposure efficiency computed from an individual's

probability of exposure, the fraction of the total audience who represent the target segment and a seasonal factor. Nevertheless the success or failure of the approach is determined by how effectively the fluctuating exposure value may be measured.

Of the simulation approaches concerned with assessment in terms of exposures, Gensch's⁽¹⁰⁸⁾ model is a good example of the detail which can be incorporated into the weighting of the exposures. It takes into account the individual's target weight, the ad form weight, frequency weights and other media appropriateness weights.

The heuristic programming efforts of the group of English authors represent probably the most exhaustive and complex mathematical treatment of the problem of maximizing reach and frequency. Lee and Burkhart's⁽¹⁰⁹⁾ model objectives was to maximize the 'effective coverage' or the gross impact, i.e. the total number of times the advertisement is noticed. But again the approach despite its comprehensiveness is limited by the sheer complexity of the media problem. Their 'effective coverage' was maximized only for the case of having one or no advertisement in each medium, the schedule being restricted to a choice of the media to be used and the size of insertion in each.

Ellis⁽¹¹⁰⁾ is more acutely aware of the restrictiveness of media models concerned simply, with reach and frequency. His conception of 'effective exposure' is defined as being one where an individual reads the issue in which the ad appears, he notices the advertisement and is sufficiently impressed to respond. The proportion of the target population who have been 'effectively exposed' to one or more advertisements is then defined as 'effective coverage.'

Lee⁽¹¹¹⁾ found it impossible to maximize reach and coverage simultaneously (see earlier), but suggested that a meaningful alternative would be to maximize one criterion subject to a restriction on the other. Taylor's⁽¹¹²⁾ criterion function is a combination of coverage and impact and represents a compromise between the two criteria.

Of the few attempts in media scheduling theory to go beyond mere exposure as a criterion, Beale, Broadbent and Hughes⁽¹¹³⁾ assessment model has probably the most widespread commercial viability. Firstly, their assigned perception value weighting involves consideration of the creative content of the message, the people at whom the message is aimed and even goes so far as to address itself to the question of subliminal perception. Secondly, for press advertisements, the approach recognises that the editor environment of different publications may affect the attitude with which people receive the advertising. This factor is incorporated in their selectivity weighting. Finally, the model specifies a creative impact value which considers the gains from an individual seeing a large press advertisement compared with a small one, or colour versus black and white. Schedule effectiveness, as described in Section I, is then taken to be a weighted cumulative frequency distribution of impressions, where the probability of receiving an impression is a composite of the perception, selectivity and impact weightings, multiplied by a series of response function values.

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A second attempt to go beyond exposure was incorporated in Lee's dynamic model which concerned itself with the problem of spacing advertisements over time. The criterion for this formulation was taken to be awareness measured by advertisement recall. The objective is then to design a media schedule to produce the desired levels of awareness at specific times. Whereas exposure only relates to the potential for having seen and noticed a particular ad, awareness implies some ability to recall an advertising message. Since awareness is somewhat closer to the ultimate sales and profits goals of advertising, it would seem reasonable to expect it to be a better predictor of the sales and profits effects of advertising than exposure measures.

Unfortunately, the use of such after exposure measures as ad recall tend to remain outside the scope of the media planning theorist. Further since advertising research tends to be more concerned with the practical problems of measurement of ad recall, rather than its use as a tool of comparison for communication schedules, any contribution toward its inclusion in the media planner's analytical tool kit is unlikely to come from the field of advertising theory.

Conclusion

In the context of possible measures for assessing or constructing communication schedules, two broad conclusions emerge.

Firstly, there is the data problem itself. At present, information relating to media exposure abounds, and the concepts of weighting target respondents, of weighting successive exposures etc., remains a logical extension of the data availability. However, the problem of deriving awareness measures over time and of setting up ad recall and recognition tests to supplement the exposure data, represents an entirely new area of concern. If the provision of such media data is to prove of use to media practitioners it must be linked to existing data and classified accordingly. Herein lies the problem, since to derive this information in a comparable form so as to provide a data base to extend the criteria for media selection available to the planner, involves a great deal of effort and more important, a high cost outlay. This cost factor is likely to prove the greatest inhibitor to the gathering of information on communication measures beyond exposure.

The second problem in establishing measures such as ad recall and recognition is a compound one. Firstly, there is the problem of tradition. Since the practice of even thinking in terms of frequency of insertion rather than frequency of exposure is dying remarkably hard, one might well expect the practice of thinking in terms of media awareness or recall to be an even harder pill for the media analyst to swallow.

More important, however, the dual criteria of reach and frequency or weighted variants thereof, would seem to lend themselves more readily to the optimizing approaches of the communications scheduler than awareness or recall criteria. The difficulty of incorporating these latter measures within the current methodological approaches to the problem may well provide some justification for the current traditional media outlook.

The 'objective' of this section has been to point out the criteria which media approaches have traditionally sought to maximize, or have employed in order to assess potential communication schedules. Some of the shortcomings of these measures have been discussed and the borrowing of measurement criteria from advertising theory suggested. The discussion has deliberately not focused on the more behavioural aspects of communication including the possible use of attitude change as a further alternative to exposure or insertion criteria. Such considerations are felt to be beyond the scope of this paper.

Section V Weighting Factors

The concept of a weighting factor is an implicit recognition that despite the sophisticated often quantitative rigour of the media scheduling approaches, some aspects of the allocation process draw heavily on the subjectivity of the communications practitioner.

In certain cases, this subjectivity may reflect the desire of a client company to have a particular media vehicle included in the schedule or the desire to reach a particular segment of the target population. In other cases, a certain element of objectivity may be introduced into the weighting factor; for example, the editorial climate or product fit may be taken into account in assigning weightings to different media vehicles. Probably the most important area in which the weighting factor has received recognition is in the context of successive media exposures. In its more familiar form, the treatment of successive media inputs on the respondent individual, manifests itself in the response function.

However as yet an area which has been woefully neglected in terms of the application of a weighting factor is in considering the time element. While different functional forms have been given to the dynamic effects of communication in classic advertising theory, media planners have with only few exceptions, not succeeded in building the time factor into media models.

Quantitative models using linear programming, dynamic programming, iteration, heuristic programming and simulation have been designed to select media schedules. These models have been reviewed in the literature and most use media weights. But while these approaches tend to stress the functional relationships laid down in such models, there can be little doubt that the accuracy and usefulness of any of the quantitative models is heavily dependent on the quality of the media weight estimates. To recognise the importance of media weights is not new but what is surprising is that despite this acknowledged importance, there has been little discussion of the media weights themselves.

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Gensch makes a number of general comments concerning the input media data used to construct the weightings. While admitting that most media models use aggregate weights because the algorithms used cannot handle the data on an individual basis, Gensch points out that most of the available data exists in aggregated form, broken down into a number of subgroups according to demographic and socio economic characteristics. The model builder, in using such data, usually assumes independence between these subgroups. Ideally individual weights should be used, derived from sample information.

The following discussion builds on the classification of media weights laid down by Gensch.⁽¹¹⁶⁾

(i) Target Population Weights:- media approaches seem fairly agreed on the terminology employed to describe a weighting which reflects the fact that an advertiser considers certain members of the population to be of greater importance to him than others. Criteria frequently used to identify and value such a target group include past purchasing activity, socio economic variables, and personality traits. Many media approaches restrict themselves to a single variable but employ a number of attributes to reflect the planner's predetermined evaluation of reaching different segments within the target population. In some cases clearly, variables and some attributes will vary in importance, thus strictly speaking weighting should be on an inter and intra basis.

A major reason why media approaches have not incorporated such composite differential weighting systems for the target segment is that in many cases the pertinent variables and attributes possessed by potential purchasers are not known.

(ii). Media Vehicle Appropriateness Weights:- traditionally, this concept has been restricted to assessing different media vehicles within the same media class. Unfortunately, little work has been carried out on assessing the relative efficacy of receiving messages in different media classes.

Nevertheless, most models make an acknowledgement to the fact that there is an interrelationship between the vehicle and the advertising message it delivers to an audience, Alfred Politz⁽¹¹⁷⁾ stated the following in his introduction to his Reader's Digest - Saturday evening post study -

"Exposure is entirely the responsibility of the medium, though the medium's function goes beyond that - into the mood it creates in its readers, viewers, or listeners, their confidence in the medium and other benefits the medium delivers for its advertising content."

Winick⁽¹¹⁸⁾ used paired comparisons methods in testing how the same advertisement might be conceived in the context of two different magazines. Winick concluded -

"Where advertising is placed - its vehicle - affect recall of its message, rating of its sponsor and return of its coupon".

Once it is accepted that the media vehicle affects the media effectiveness, exposures from different vehicles must be weighted accordingly. The following is a list of factors suggested by Gensch⁽¹¹⁹⁾ which may influence the media vehicle appropriateness weight:-

1. Editorial climate
2. Product fit
3. Technical capabilities
4. Competitive advertising strategy
5. Target population receptiveness
6. Product distribution system

One or other of the above or a variant thereof is incorporated in the 'relative weight attached to journal j' term in many of the programming approaches reviewed earlier (see Aaker⁽¹²⁰⁾ Brown and Warshaw⁽¹²¹⁾ etc), it corresponds to Carpenter's qualitative media weight⁽¹²²⁾ and again Brown's⁽¹²³⁾ relative exposure effectiveness factor.

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(iii) Commercial Exposure Weights:- Gensch argues that there are really two systems of commercial weights, The first set attempts to predict the number of commercial exposures, given the number of vehicle exposures. The second set is more concerned with perception of the ad, once exposure has occurred. Exposure as it has been used throughout this chapter is taken to be simply the opportunity to perceive whereas

perception is defined as implying that some cognitive action has been taken by the individual.

The problem of assigning and determining media weights is most usually carried out on a probabilistic basis. Thus a commercial exposure weighting factor is incorporated as a value to represent the probability that an individual is exposed to the advertisement given that he reads an issue of the media vehicle containing it. (see for example, Broadbent, Beale and Hughes⁽¹²⁵⁾ perception factor which despite the misleading terminology is the probability that readers/viewers will open their eyes in front of an advertisement), (similarly Brown⁽¹²⁶⁾.)

(iv) Commercial Perception Weights:- The problem now is that given exposure to a commercial message, what is the probability that an individual will consciously perceive the message? As pointed out earlier (see Section IV) media approaches have contented themselves with exposures as objective criteria. Consequently, the methods most commonly used to measure perception, notably recall and recognition, are to be found more widely employed in classic advertising studies.

In recognition tests, a subject is shown a magazine and asked if he can pick out the ads he recognises from a previous reading. Unaided recall asks him to list these ads. Aided recall gives the subject clues as to what the advertisements were. Both of these tests measure not only if the subject actually perceived the advertisement but also if the subject consciously remembers what he perceived, in which vehicle he perceived the ad and when he perceived it.

Troldahl and Jones⁽¹²⁷⁾ looked at four factors affecting the probability that a newspaper ad is 'seen'. Page size and type of product advertised were found to be highly significant, explaining 60% of readership variation. Page size alone explained 40%.

Starch⁽¹²⁸⁾ reports that,

"readership as a rule is directly proportional to the size of the advertisement with the exception that a full page attracts not quite twice as many readers as a half page ad, and a two page ad attracts not quite twice as many readers as a full page".

To provide a simple heuristic rule for use in quantitative models, functional relationships between page size and exposures have been suggested,⁽¹²⁹⁾ The best known approach is that of Lee and Burkhart who proposed that the change in attention is equal to the square root of the multiple by which one changes the page size (e.g. if 100 people observe a quarter page ad., 200 people are expected to observe a full page ad). There is however little published research to test this rule. Gensch⁽¹³⁰⁾ argues that,

"most researchers suggest that a strict functional relationship between attention and any one of ~~the~~ several variables is convenient but naive."

Next to page size, the variable most often considered is use of colour (Assael, Kofren and Burgi.⁽¹³¹⁾)

There is however evidence to suggest that weighting advertisements on the basis of features of the advertisement may be only part of the problem. Buchanan⁽¹³²⁾ reports that interest in the product significantly affects recall. Again Trolldahl and Jones⁽¹³³⁾ found the product advertised to be significant in predicting rating scores.

CONCLUSION

In essence, weighting factors in media studies have been applied to subsegments of the population to reflect the planner's preference for certain individuals, to the media vehicles themselves to reflect their a priori suitability for these target individuals, to the likelihood of a respondent of the target population being exposed to an advertising message in a suitable media vehicle and finally, to the likelihood of that respondent perceiving the content of the message in the media vehicle. In this way the media planner attempts to impose his judgment of the most suitable, receptive media form on the structure of the schedule to be selected or constructed.

However, it is unlikely whether the media planner, in attempting to bridge the gap between exposure and purchase by a respondent, can designate the effects of even the most persuasive media vehicle by recourse to characteristics of the media vehicle alone, clearly such factors as page size, type of product etc. will have some effect in determining a respondent's likelihood of attending to and perceiving the message. But in the event, the more behavioural aspects of communication, namely the recipient's perception of the credibility of the media, his experience of the product contained in the message and his selective processes in general, are likely to be more significant determinants of the individual's propensity to act in response to the message. The media planner might argue that he does not have the resources nor the inclination to investigate how the characteristics of the respondent will determine the receptivity of his message, but only when attention is devoted to constructing a descriptive profile of individuals in the target segment of the population, can a meaningful communications policy be formulated.

Section VI Cumulative frequency Weights - The Response Function Concept

The problem is how to evaluate the effects of successive exposures to the media message. Many of the media programming approaches are deficient in assuming that repeat exposures have the same effect, viz, that the tenth exposure to the message has the same effect on the respondent as the first. Secondly, for those approaches which do propose a response function of some form, very few incorporate discussion of the rate at which response builds up in time as a result of successive exposures and decays thereafter, or about the link between intermediate measures such as issue reading, advertisement noting and even attitude change and the ultimate objective of increased sales.

At its simplest, a response function is a mathematical relationship linking the magnitude of the media 'effect' generated, to the number of media exposures or impacts.

Essentially the response function is introduced as a formula to show the cumulative advertising value of repeated impacts on an individual.

Carpenter ⁽¹³⁴⁾ suggests the following:-

"A response function defines the value of 'repetition' by describing it in terms of the additional value represented by either brand name recall, copy recall, brand attitude, probability of purchase or even direct sales units produced by each successive impact on the individual".

But Webb ⁽¹³⁵⁾ in his first rate treatment of advertising response functions in media planning, is quick to point out that:-

"measuring the response function is more difficult than measuring advertising effectiveness since it involves measuring exposure as well. It is an intuitively meaningful concept but practically nebulous."

The most serious problem with response curves, as pointed out in Rothman's excellent paper on the use of response functions, ⁽¹³⁶⁾ is that there is no generally accepted definition of response. A succinct statement of the problem of the meaning of response is offered by Rothman, from which the following is an extract:-

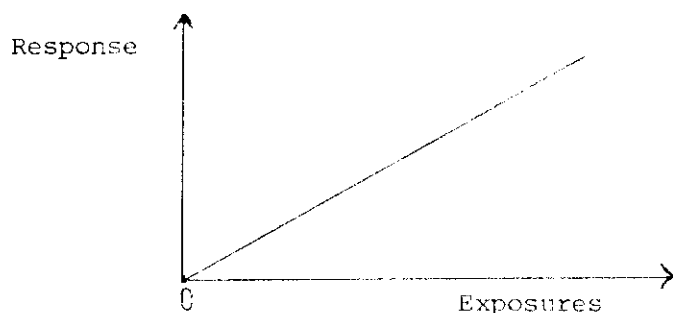
"The problem of defining response leads on to the whole question of what advertising theory does. Presumably the school of thought that believes that advertising generates immediate additional sales, and has no long term effect, would define response in terms of the sales generated by this advertising. The DAGMAR school, however, is faced with a more serious difficulty in most cases. Even if the goal of the advertising campaign is defined in very simple terms, such as the creation of spontaneous brand awareness, we have the difficulty that no response at all can be achieved from those members of the population who are already spontaneously aware of the brand.

Since spontaneous awareness is unlikely to be spread evenly through the population, this means that each group of the population must be assigned a target weight proportional to the percentage of that group which is not spontaneously aware of the product. Whilst manoeuvres like these are perfectly feasible, they would seem to be unrealistic, in the sense that it is most unlikely that any campaigns effect will be confined simply to the creation of spontaneous awareness.

Once we have a campaign with multiple goals, we must find some means to evaluate in common terms the response which is assigned to a person who, from total non-awareness moves to prompted recognition, as compared with that which should be assigned to a person who moves from prompted recognition to spontaneous awareness.

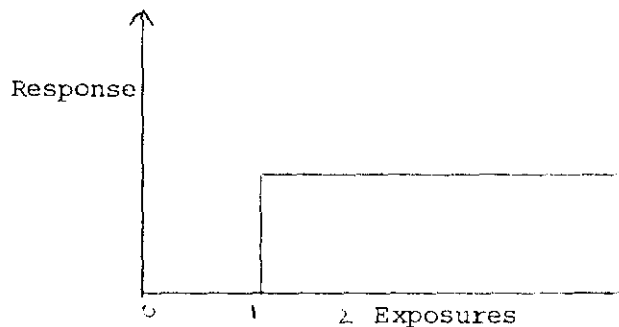
In a more realistic situation, involving not only changes in awareness but changes in attitude along a number of different dimensions, together with varying degrees of recall and comprehension of the advertising message, it will be appreciated that the meaning of response becomes very complicated indeed."

The conventional media planning approach of considering impacts and coverage is equivalent to the use of one particular type of response curve. Thus, the media planner who assesses schedules according to the number of impacts achieved amongst certain specific target groups is simply using for these groups a response curve which has the following form (Rothman⁽¹³⁷⁾)



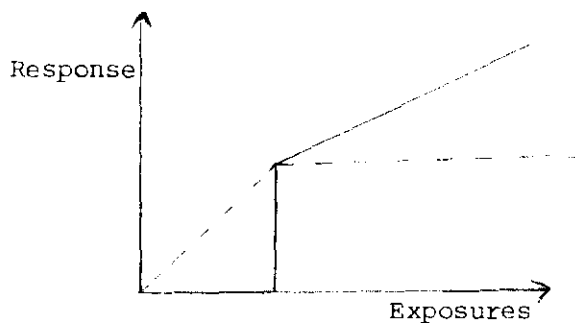
Assigning different weights to different target groups is merely equivalent to employing lines of different slopes proportional to the weights assigned for the different target groups.

Similarly, a media planner who assesses schedules on the basis of coverage only is employing a response function thus



Again different heights can be used to indicate the importance attached to different target groups.

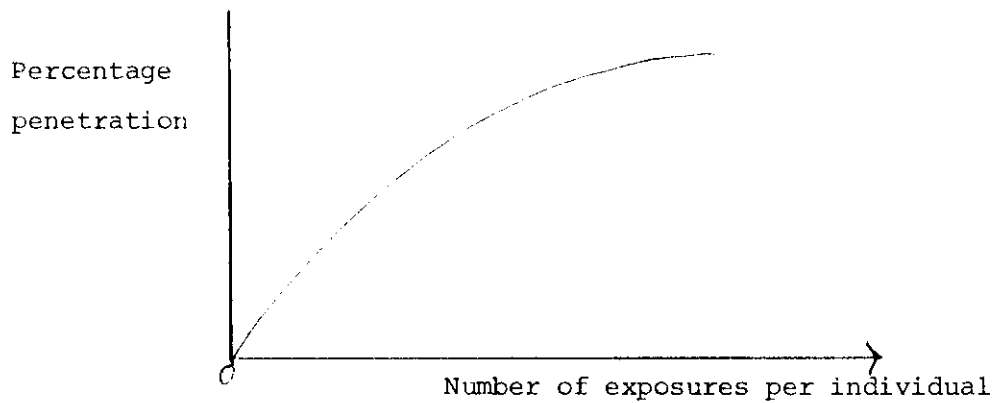
Finally, if a combination of both impact and coverage is used, then



In addition to such basic criteria, subjective judgments of media planners are often built into the response function in an effort to formulate a more realistic and reliable analytical tool.

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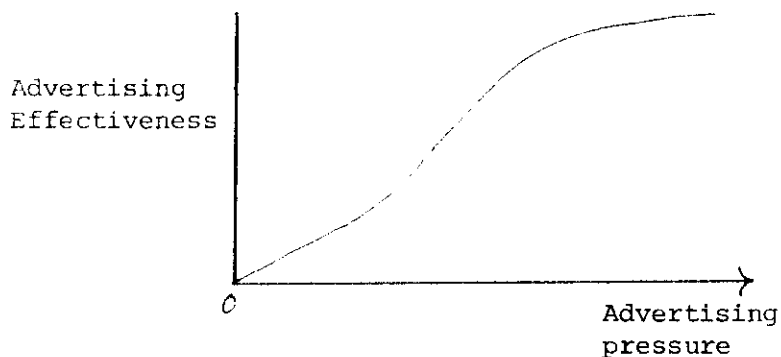
Steinberg and Agostini represent an example of a modified impacts curve building in saturation phenomena. The latter being a statement of the fact that beyond a certain number of exposures, further exposures produce little or no additional response. In Steinberg's model, percentage penetration is taken as the percentage of the population who recall the media message.



Response functions typically have a number of characteristics of which Webb⁽¹³⁹⁾ recognises the following:-

- (i) a threshold number of impacts or opportunities to see, below which there is little response.
- (ii) a section of increasing response where each additional impact produces a response greater than the previous one.
- (iii) a section of increasing saturation when each additional impact produces a declining response.
- (iv) complete saturation when each impact produces no response.

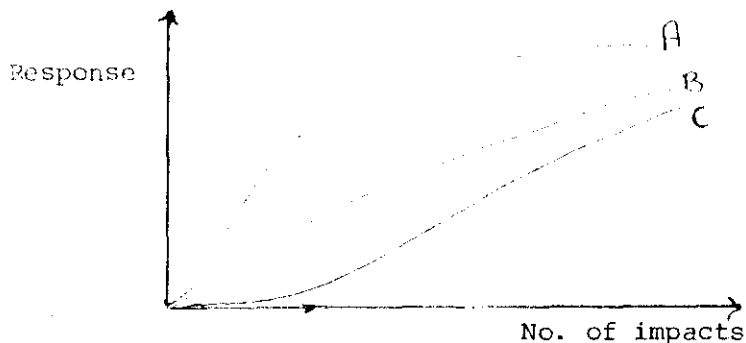
The most general response curve shape employed in the media approaches processes all of the above characteristics and has a general S shape. For example, Marc⁽¹⁴⁰⁾



(Similarly, Carpenter,⁽¹⁴¹⁾ Brown and Warshaw⁽¹⁴²⁾). But even the most widely accepted form of response function suffers from a number of general defects.

Firstly, both Rothman⁽¹⁴³⁾ and Carpenter⁽¹⁴⁴⁾ admit that the concept is an aggregate one, i.e. a response function is defined for the population as a whole or specific sub-groups. To be realistic, a media model should employ different response functions for different population sub groups. In addition in this context, many media planning approaches seem to assume that the shape of the response curve which should be sought is that for an average or typical individual. In fact, what is really required is the mean of the response curves for the population under consideration which is something vastly different.

Secondly, Carpenter⁽¹⁴⁵⁾ similarly Broadbent⁽¹⁴⁶⁾ point out that the shape of the response function is likely to vary according to the nature of the communication objective. For example.



Where A is the response curve where correct brand name recall is taken as the objective; B the curve where the objective is to induce an increasingly favourable attitude shift and C where the objective is one of initiating a first purchase.

Before moving on to consider the third defect of response functions currently employed in media models, namely that no allowance is made for the fact that time elapses between advertisement exposures, Webb⁽¹⁴⁷⁾ has some interesting comments to make on the widespread use of this media tool in preparing and evaluating proposed schedules, in view of the restrictions on the validity of the response function concept:-

"The response function is regarded by some as a model of the actual advertising process as it takes place in individuals subjected to increasing amounts of advertising. If it were and the parameters of the function were known, then it would be natural to calculate advertising expenditure on the basis of the effect of the advertising campaign in achieving the firm's objectives by relatively straightforward calculations. That this is not even seriously advocated as a method of calculating advertising appropriations indicates clearly a rejection either of the response function as a model of the actual advertising process or of the parameters being known or both. Thus optimizing with one nominated response function regarded in this way is like using a scalpel in the darkness".

Section VII Time Factor: The Dynamic Effects of Media Placement

Irrespective of the shape of the response function, to write down any relationships between 'effect' and number of impacts or exposures or whatever variant thereof may completely neglect the variation of effect with time. All of the response functions discussed so far in this section imply that the cumulative effect of three impacts would be the same were they delivered on the same day, at weekly intervals or for that matter, with a year between each.

Media approaches which have considered the time element include, Lee⁽¹⁴⁸⁾
Little and Lodish⁽¹⁴⁹⁾ Zangwill⁽¹⁵⁰⁾ Carpenter,⁽¹⁵¹⁾ Marc⁽¹⁵²⁾ Ray and Sawyer⁽¹⁵³⁾
Rothman⁽¹⁵⁴⁾ Consterdine,⁽¹⁵⁵⁾ Moran.⁽¹⁵⁶⁾

The approach of Carpenter⁽¹⁵⁷⁾ and Little and Lodish⁽¹⁵⁸⁾ is illustrative of much of the work carried out on dynamic effects, in classic advertising theory which deals very much more extensively with the problems of accumulation and carry over effects and decay effects. Carpenter⁽¹⁵⁹⁾, for example, suggests a simple theoretical advertising model based on the idea that at any given point in time, each member of the population possesses a decayed cumulative dosage of advertising effort. This decayed cumulative dosage is dynamic and decays over time but receives boosts each time an advertisement impact is received. For any one individual, advertising response is then related to the decayed cumulative dosage by means of a response function.

This concept of maintaining a constant level or "tank of exposures" has its origins in a paper by Nerlove and Arrow⁽¹⁶⁰⁾ who derive a mathematical solution to the problem of maintaining this level of advertising exposures constant, by equating the flow of future successive advertising inputs to the rate at which past exposures decay. The argument is that the advertising policy is optimal when the respondent is subjected to the optimal level of advertising pressure which produces a favourable predisposition toward purchase and is kept at this level by equalizing the cumulative and decay flow rates.

On a simple experimental footing, Zielske⁽¹⁶¹⁾ reported the results of an experiment at Foote, Cone and Belding in which groups of respondents were mailed thirteen different advertisements from one print advertising campaign at intervals of either one week or four weeks. "Effect" in terms of awareness of the brand name on prompting with the product field was then measured at various intervals.

A more interesting development is made by Brown⁽¹⁶²⁾ whose approach to the problem of scheduling insertions over time stems from a re-analysis of Zielske's work by Rohloff. This re-examination showed firstly that the decay in awareness is exponential in form, secondly that the rate of decay is independent of the initial level of awareness, but does depend on the frequency of prior exposure. These two propositions are represented mathematically by Rohloff:⁽¹⁶³⁾

$$r_t = r_o e^{-k_1 t} \quad \text{..... (i)}$$

where

r_t is the level of awareness at time t

r_o is the initial level of awareness

k_1 is a constant representing the rate of decay

and secondly,

$$\log k_1 = k_2 - k_3 \log f \quad \text{..... (ii)}$$

where f represents the frequency of prior exposure, k_2 and k_3 are constants

Finally, he suggests that the level of awareness immediately subsequent to an exposure r_a is given by

$$\log r_a = k_4 + k_5 \log r_b \quad \text{..... (iii)}$$

where r_b is the level prior to exposure and k_4, k_5 are constants

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Brown makes a number of simplifying assumptions and then takes the ratio of cost to the level of awareness integrated over the schedule. He suggests that all possible combinations of vehicles/number of insertions within a budgetary constraint be listed and then proposes that all possible patterns of insertion through the schedule period for all such combinations could be listed. For each of these possible combination patterns, the value of schedule cost/awareness integrated over the schedule period would be calculated; for any given population sub group, homogenous in terms of their initial level of awareness and incidence of impressions from the schedule pattern, the incremental effect from such exposure would be calculated in terms of equation (iii) and their then current awareness; and awareness-decay curve between exposures from (i), and (ii) i.e. their frequency of prior exposure and their awareness level at the start of that period. Finally the vehicles/numbers of insertions/pattern combination showing the best cost ratio would be selected.

The approach is somewhat unsophisticated and by no means moves any nearer to a solution to the considerable problems of measurement involved, but its value lies in its attempt to introduce and combine dynamic models of advertising theory with traditional media planning methods.

In this context an approach which clearly represents the way ahead lies in a paper in the realms of management science by Montgomery and Silk⁽¹⁶⁵⁾ The procedure is particularly worthy of note since it represents an integrated view of communication media, considering personal selling, direct mail and journal advertising in a dynamic context. It is essentially a descriptive model and does not seek to offer an optimizing approach to the scheduling of the different media. Neither does it take into account the difference in effectiveness between media. The model uses the distributed lag formulation familiar to many of the advertising studies of cumulative effects, and permits the use of a different lag structure for each communication variable, thus at least recognizing that the rates at which the individual respondent forgets, i.e. the message decays, will vary according to the nature of the communications media

itself. In addition, it allows for interaction effects among communication media on the dependent variable. (taken to be market share).

In concluding this section, it may be said that very few of the 'pure' scheduling approaches, apart from Little and Lodish⁽¹⁶⁶⁾ manage to successfully handle the timing problem. Allocation models whether optimizing or assessment approaches, which consider media schedules at a static point in time are clearly defective. The first step must be surely to conceptualise the response function in an integrated, dynamic framework. In other words, media inputs should be weighted according to such considerations as the likelihood of reaching a target individual, the appropriateness and credibility of both the media vehicle and the general media class, in order to build up a weighted response function which reflects the different persuasibilities of outputs in a current media schedule. In addition, such response functions should ideally be constructed for each media vehicle or class individually in order to incorporate the different rates of decay or forgetting associated with each media, and allow a dynamic picture of the communications pressure of the target audience to be built up. In this way, functions derived from advertising theory to describe the shape of these dynamic effects could be used, and a total weighted dynamic response function constructed to indicate the most suitable media output in the current media planning horizon, given the communication pressure carried over from previous planning periods still operating in the audience.

Thus at any point in time the media planner would be aware of the current pressure operating from previous exposures and be able to phase future messages over time in order to reinforce the current audience exposure pattern.

In view of the current state of the art and the considerable, perhaps insurmountable problems, in implementing such an approach in operational terms, the conceptual ideal may remain no more than a media planner's dream.

However, given the present techniques available, there would seem no reason why some effort on behalf of the more adventurous media researchers could not be channelled in this direction and some attempt made to go beyond the mere conceptualization of such an integrated, dynamic approach and add some theoretical detail to this skeletal framework. The problem is to push back the conceptual frontiers of media theory and suggest areas and directions for future research while at the same time offering day to day help for the media practitioner.

Nevertheless whatever the current needs of the media planning industry in general, approaches which have traditionally sought to improve the mathematical techniques at the expense of relegating the practical realities to restrictive assumptions, are unlikely, either to suggest directional guidance or offer immediate assistance to the media planner.

Section VIII Conclusions.

This paper has attempted to review the major current approaches to the problem of media scheduling. It has pointed out some of the deficiencies of these models and has examined some of the underlying assumptions. Secondly, a discussion of criteria frequently used by media planners in assessing media schedules is provided, together with a consideration of how such objectives are linked to the overall communication strategy.

Thirdly, the concept of the response function in media planning studies has been touched on, although only brief reference has been given to related advertising effectiveness studies which fall outside the scope of this paper.

Fourthly, the importance of the dynamic element in communication assessment is stressed, together with a call for the need of incorporating work done in the advertising field within the construction of media models.

Finally, an outline of an integrated, dynamic media scheduling model is tentatively suggested and a broad direction of the nature of future media research in this context offered.

Clearly, the problem of selecting media in order to place advertising messages so as to exert the greatest effective communication pressure on an individual, is far from simple. The media scheduler is faced with the added difficulties of allocating the budget among competing media vehicles of different persuasibilities, over and above the problems encountered in the realms of assessing advertising effectiveness. It is perhaps no small wonder that the media practitioner, in the face of such a wealth of academic omniscience, can find time to cope with the everyday problems of providing and maintaining a media service to customer clients.

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