

## **Matching a message to an audience --- What does this mean?**

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**Abstract** --- Great changes in public sentiment have occurred in regard to some public health issues in recent decades. But other campaigns have had disappointing results. An idea that has been proposed to explain this variation is that the tone of a public health message (for example, a road safety message) needs to match the personality of the audience receiving it. This might also be true of, for example, a message promoting public transport. If the necessity of matching message to audience is a reality, it refers to what is termed crossover interaction in a factorial experiment: one thing is superior to another in condition 1, but is inferior in condition 2. A model for this involves taking the numerical difference between two quantities, and then some nonmonotonic function of the difference. In the present context, that would be measuring the tone of a message and the personality of the audience on the same scale, calculating the difference, with the response being an inverted-U shaped function of the difference. That is, the biggest response occurs for the smallest difference. The present paper attempts to integrate (on the one hand) the words that have been used in specific instances of heterogeneity of effects with (on the other hand) the mathematical symbols and expressions intended to be adaptable to a broad range of applications. Making a mathematical model familiar will facilitate the communication of particular instances of its use.

### **1. Introduction**

Two things lie behind the present paper.

- Much work in social psychology gives a lot of emphasis to interaction, that is, something having one effect in one condition and a different effect in another condition. Yet there is often no articulate explanation of why an interaction is occurring.
- There have been some suggestions in the literature on marketing that different styles of messages work best for different types of audiences. In other words, the style needs to be

targeted to the audience the message is aimed at.

These come together in their relevance to advertising aimed at (for example) making people drive more safely, or change their chosen mode of transport. The purpose of this paper is to propose a model of how interaction may occur, and to give examples relevant to road safety and transport more broadly. Thus it is a theoretical paper, suggesting how data might usefully be modelled.

The paper will be organised as follows.

- Social and health messages --- a few words emphasising the variation in findings.
- Terminology of factorial experiments.
- The fit between a person and an environment --- explanation of this concept.
- Additivity followed by nonlinearity.
- The fit between a message and its audience --- examples where fit may be relevant in the study of communication effectiveness.
- Other examples in road safety and communication.
- Is it practicable to estimate the parameters of a nonlinear model?
- Discussion.

## 2. Social and health messages

Government often wants to get social and health messages over to its population, and thereby change behaviour. There is a wide range of opinion about the effectiveness of mass media.

There is quite a substantial body of opinion, based on evaluations of individual campaigns, that advertising and education campaigns will not usually improve driver behaviour. The abstract of the article by Lewis et al. (2007) begins as follows: "Threatening advertisements have been widely used in the social marketing of road safety. However, despite their popularity and over five decades of research into the fear-persuasion relationship, an unequivocal answer regarding their effectiveness remains unachieved." See Atkin (2001, pp. 31-33) for discussion of reasons why campaigns fail. The review by Lund and Aarø (2004) is quite pessimistic about preventing accidents by changing attitudes. According to Strecher et al. (2006, p. 35), "One-size-fits-all mass media interventions that run independently of other strategies have demonstrated little or no behavioural improvement."

On the other hand, there seem to have been enormous changes in some attitudes over the

past 30 years --- less tolerance of smoking, drink-driving, and speeding, for example.

Reasons for this contradiction are not well understood. Among the possibilities are those following.

1. Perhaps advertising often does have an effect, but this takes a long time to become apparent.
2. Perhaps advertising usually has no effect, and the positive results sometimes claimed have been due to other causes.
3. Most of the negative opinions have been worded as there being no proof of effectiveness --- rather different from proof of no effectiveness.
4. Some of the controversy may arise from the use of different measures of effectiveness --- e.g., attitudes or behaviour or number of crashes.
5. It may be that only some forms of advertising are effective.
6. It may be that advertising is effective only in some conditions --- e.g., when accompanied by enforcement.
7. It may be that the style of a message interacts with characteristics of the audience in respect of the effect it has. That is, one style might change the attitude of one audience, and a different style change the attitude of a different audience. If this were the case, then it would not be surprising if results turned out to be confusing and contradictory.
8. Very likely, there are other possibilities beyond these (e.g., the suggestion by Henley and Donovan, 1999, that threats of death may be qualitatively different from other threats).

For present purposes, this list is background. The present paper discusses number 7 on the list, the idea of a need for compatibility between the message and its audience.

## 3. Terminology of factorial experiments

Factorial experiments are those in which a category of one factor (independent variable)

is combined with a category of another factor. If the first factor has the same effect whatever category of the second factor we are referring to, there is said to be no interaction between the factors. Interaction refers to different effects of the first factor for different categories of the second factor. Crossover interaction refers to effects of the first factor that are in opposite directions for different categories of the second factor.

A common notation is to let  $y_{ij}$  be the dependent variable when category  $i$  of the first factor accompanies category  $j$  of the second factor, and  $A_i$  and  $B_j$  be quantities associated with the two factors. Interaction would refer, for example, to  $y_{11} - y_{12}$  being different from  $y_{21} - y_{22}$ . Crossover interaction would refer, for example, to  $y_{11} - y_{12}$  being different in sign from  $y_{21} - y_{22}$  (i.e., one difference is positive and the other negative). The absence of interaction means that  $y_{ij} = A_i + B_j$ . The  $A$ 's and  $B$ 's are parameters of the model, that are estimated from the observed  $y$ 's.

#### 4. The fit between a person and an environment

*Example 1.* Roberts and Foti (1998) found job satisfaction to be higher for employees having high self-leadership who worked in low structure environments, and for those with low self-leadership who worked in high structure environments. One factor here is employee personality (high in self-leadership versus low), and the other factor is working environment (low in structure versus high). The dependent variable is job satisfaction. The results of Roberts and Foti might be described as showing the importance of a fit between people having low self-leadership and work having low ambiguity, or people having high self-leadership and work having high ambiguity.

The idea of fit between a person and a job, performance being better when there is a good fit than when there is misfit, is one that recurs in occupational psychology.

Let's take the word "fit" seriously. What do we mean if we say that a shoe fits a foot?

- There is a concept of length, characteristic of the foot and characteristic of the shoe,  $F_i =$  length of foot  $i$  and  $S_j =$  length of shoe  $j$ .
- What matters is the difference  $F_i - S_j$ : if this is close to zero, the fit is good, and if it is large positive or large negative, the shoe is too tight or the shoe is too loose.
- That is, if comfort  $C_{ij}$  of shoe  $j$  for foot  $i$  is plotted versus  $F_i - S_j$ , it has a maximum for  $F_i - S_j$  close to zero, getting smaller either side.

The reason for considering how  $C_{ij}$  depends on  $F_i - S_j$  is to draw a connexion with the results of factorial experiments. If we observe some dependent variable in various combinations of conditions, the usual baseline hypothesis is that each factor has the same effect, whatever the other factor is. That is, there is no interaction. When interaction is found, it is often the case that no articulate explanation is given for the interaction.

#### 5. Additivity followed by nonlinearity

If the observed interaction refers to big shoes being best for big feet, whereas small shoes are best for small feet, the fit of one thing to the other is the obvious explanation. My opinion is that it should be considered as an explanation when it is not so obvious, also.

When no other explanation comes to mind, it may be worth considering additivity followed by nonlinearity (see Hutchinson, 2006): quantities derived from the two factors combine by addition (or subtraction), and then the dependent variable observed is a nonlinear function of the result. In the case of a hypothesis of fit and the existence of an optimum fit, the function will be not only nonlinear but also nonmonotonic: inverted-U in shape when comfort is measured positively.

Addition (or subtraction) followed by nonlinearity would imply the following model:

$$y_{ij} = a + b.f(A_i + B_j) \quad (\text{Equation 1})$$

where  $f$  is some function, the nonlinearity of which is the source of the observed interaction. Whether the model is expressed as addition or as subtraction is a matter of choice, as  $A_i + B_j = A_i - (-B_j)$ . In the first case,  $B$  would be regarded as being of the same nature as  $A$ , and  $A_i + B_j$  is the total. The second case represents the idea of a fit, or  $A$  being expressed relative to what  $-B$  is.

As an explanation of interaction, additivity followed by nonlinearity is well known in some contexts. For example, the response scale in use may be subject to ceiling and/or floor effects (insensitivity at the upper and lower extremes). In the communication and marketing field, it was a sufficiently obvious idea to J. W. Hutchinson et al. (2000) that they present it without much comment (the early steps in their Figure 1).

The idea of matching or fitting immediately implies a nonmonotonic function, and hence potential for crossover interaction. Crossover interaction can arise by other means, also. Starting from interaction without crossover, crossover interaction may arise by a factor having a direct effect as well as an effect via  $f$ , as in  $y_{ij} = a + b.f(A_i + B_j) + C_i$ . Again starting from interaction without crossover, aggregation of two instances of this may lead to crossover interaction (see Figure 1 of J. W. Hutchinson et al., 2000).

## 6. The fit between a message and its audience

*Example 2.* It is sometimes said that some aspect of the style of a public health message should be targeted to some aspect of the audience. Goldstein (1959) found that a strong fear appeal receives greater acceptance among those he referred to as copers than among those he referred to as avoiders, while a minimal fear appeal receives greater acceptance among avoiders than among copers. He was able to refer to

other literature supporting the idea of individual differences in reactions.

There has been much subsequent research. According to a review by Atkin (2001, p. 23), "Effectiveness can be increased if message content, form, and style are tailored to the predispositions and abilities of the distinct subgroups". Later in that review (pp. 31-32), there is discussion of mechanisms causing health campaigns to fail. These mechanisms will apply to some audiences and in some circumstances, while for other audiences and in other circumstances, the campaign would have its intended effect. Evidently, then, the hypothesis is that what matters is the difference between some aspect of presentational style (e.g., how graphic and threatening it is) and some aspect of the people receiving the message (e.g., the extent to which they are sensation seekers), with effectiveness declining either side of some optimum. Jones and Owen (2006) draw attention to the variety of different findings concerning the effect of level of threat on likelihood of behavioural change, including the possibility of an inverted-U relationship. Ulleberg (2002) considered that there are several (perhaps six) subtypes of young drivers, that a traffic safety campaign appealed least to the high-risk subtypes, and that the sensation-seeking and normless subtypes might require campaign strategies different from each other. Strecher et al. (2006, p. 30) criticised mass communication modalities for their inability to tailor health education messages according to the characteristics of the individuals making up the audience.

Some techniques of message delivery (e.g., mailed letters) permit the message to be created individually for each recipient, perhaps even taking account of the recipient's attitudes and behaviours discovered by interview beforehand. This is sometimes termed tailoring or customising the message, as distinct from targeting the message, which refers to the use of broad demographic characteristics.

The title of this paper asks what it means to match a message to an audience. Adapting the discussion in Section 4, the answer that is implicit in the notion of matching or fitting is as follows.

- There is a property that applies to both the message and the audience.
- What matters is the difference between that property for the message and for the audience. If this is close to zero, there is a good match, and if it is large positive or large negative, the match is poor.
- Maximum effectiveness corresponds to the difference being close to zero, getting smaller either side.

There could well be complications from message style and relevant aspects of the audience both being multidimensional.

*Example 3.* It may be that how bus use is promoted needs to be targeted to the audience profile. Beale and Bonsall (2007) found that marketing material encouraged bus use among some groups of people, but decreased it among others. They concluded (p. 284) that “responses to a message are conditioned by existing attitudes and behaviours.... A message designed for people who seldom if ever use buses (and thus, in theory, have greatest scope to increase their bus use) might need to acknowledge their negative image of the bus, but such an acknowledgement could alienate regular bus users”.

Personality and attitude typically persist over time, whereas mood is temporary. Faseur and Geuens (2005) report an experiment in which different styles of message accompanied different moods of the audience. Congruence of message and mood led to the most favourable attitude. (The message was commercial in nature, not public service.)

## **7. Other examples in road safety and communication**

It is sometimes said that there is synergy between publicity and police enforcement,

some of each being needed in order for there to be improved behaviour or safety. This could be described as the amount of one treatment needing to be matched to the amount of the other in order for response to be optimal, but the description is a slightly unnatural one.

Three further examples of interest are as below. The first two are of nonmonotonic relationships in road safety, and the third concerns the development over time of the impact of a message.

*Example 4.* It may be that a driver’s mental effort should be matched to the demands of the road environment (Kim and Yoon, 2002): the implication is that safety of driving declines either side of some optimum level of the difference between effort and demand.

*Example 5.* Oltedal and Rundmo (2006) note the possibility that risky driving is lower for individuals intermediate in trait anxiety than for those who score very high or very low.

*Example 6.* A related example in the study of attitudes concerns the gap in knowledge about a political issue between voters of high education and those of low education, and how this gap changes as mass media publicise the issue (during an election campaign, for example). The percentage of voters with knowledge may change nonlinearly with time, both for high-educated and low-educated voters (Moore, 1987, Figure 2). The consequence is that panel surveys at different times may show an interaction between time and level of education in respect of percentage of voters with knowledge.

## **8. Is it practicable to estimate the parameters of a nonlinear model?**

If the function  $f$  in equation (1) has an inverse, it is likely to be practicable to estimate its parameters.

However, the idea of fit is that the observed variable will decline either side of its maximum. Thus  $f$  does not have a unique inverse: corresponding to a given  $y$ , there will be two possible values of  $A_i + B_j$ . And it seems likely that once some functional form has been assumed (e.g., quadratic dependence of  $y_{ij}$  on  $A_i + B_j$ ), there will be several qualitatively different sets of  $A_i$  and  $B_j$  that correspond to local optima of the criterion. Thus estimating the  $A$ 's and  $B$ 's may be very difficult.

The conclusion I draw is that some theory about the relative values of  $A_i$  and  $B_j$  needs to be imposed --- for example, that a change from  $A_1$  to  $A_2$  is in the same direction as a change from  $B_1$  to  $B_2$ . One might have such a theory when, for example, a change from  $A_1$  to  $A_2$  corresponds to increasing stress and a change from  $B_1$  to  $B_2$  corresponds to a decreasing tolerance of stress.

If such a theory is not available, then if nonmonotonic dependence on a linear combination of the independent variables seems plausible, it might be better to avoid a research strategy that attempts to draw general conclusions from lots of different types of people and lots of different styles of message. It might be better to only consider quite a homogeneous group of people, and examine effect of style on message on them (and do not pretend that anything can be said about other groups of people), or to only consider a single style of message, and examine how groups of people differ (and do not pretend that anything can be said about other styles of message).

This will be more strongly the case in the regression context. Linear models are very commonly used, that is, a dependent variable is regressed on several independent variables. Doing this assumes that each independent variable has the same effect, whatever the others are. Such an approach is often appropriate and successful. It can be adapted to include nonlinear terms in the independent variables. But what if two or more of the independent variables combine linearly (summing or subtracting), with the

result having a nonlinear effect? Such a model cannot be handled by the usual regression methods, yet is sometimes a reasonable and plausible one, as shown in the present paper.

The difficulties would be reduced if fit could be measured directly, rather than derived from the  $A$ 's and  $B$ 's. This is not out of the question --- people might be able to say if an advertisement was too threatening for them, or not threatening enough, or about right. But this presupposes that the important dimension, level of threat, is known beforehand.

## 9. Discussion

This view of getting from inputs (e.g., concerning the nature of the message and the nature of the audience) to an output (e.g., attitude, or behaviour, or number of crashes) has three stages to it.

1. Getting from  $i$  to  $A_i$ , or from  $j$  to  $B_j$ . For example, getting from a condition labelled "high threat message" to a number, or from a label "low sensation seeking" to a number.
2. Combining  $A_i$  and  $B_j$ . This is by addition (or subtraction).
3. Getting from the result of combining  $A_i$  and  $B_j$  to the observed variable, by means of the nonlinear function  $f$ .

Organising a model according to the above three stages is an approach that has been advocated by N. H. Anderson for some 50 years (e.g., Anderson, 1981). He terms the three stages *valuation*, *integration*, and *response*. Much of his research has been on topics where averaging, not addition, is the appropriate combination rule at stage 2. Further, his work does not usually use a nonmonotonic function at stage 3. (His approach to psychophysics and experimentation has other distinctive features that are outside the scope of the present paper.) The paper by Frileux et al. (2004) is an example of research in the field of communicating health risks (heart disease,

in this case) that used Anderson's approach. Frileux et al. also give some references to theories from health psychology and the distinction between intention and behaviour.

If the concept of fit is important, with the function  $f$  being nonmonotonic, there will be great difficulties in estimating the unknowns in the model. But fit and nonmonotonic  $f$  do not become implausible just because we recognise the practical difficulty of using such a model. If the idea is plausible --- and it is discernible in a number of publications --- some way of making progress needs to be found.

The chief points to have come out of this paper are as follows.

1. If an interaction is discovered (whether in the context of public communication or not), it is highly desirable to have a clearly-articulated hypothesis about how it arises. Additivity followed by nonlinearity is a simple idea often worth considering.
2. If we take seriously the words "matching" or "fitting" a message to an audience, this implies subtraction followed by a nonmonotonic dependence.
3. Nonlinear dependence on an unknown linear combination of variables is reason for pessimism about a research strategy that applies linear regression to data from a wide range of different situations.

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