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A modified proportional change model of attitude change by group discussion

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Abstract

The data of two experiments of dyadic group discussion have been reanalysed. An extended proportional change model was designed to explain the actual process of attitude change. The model is defined by two parameters. The first represents the impact of single pro-arguments and single con-arguments on the attitude or decision preference. The second describes the resistance to further change that increases with the distance from the initial position. It was hypothesized that the first parameter should be higher and the second lower, with a similar partner than with a dissimilar one. The prediction was confirmed for the first parameter only. A comparison of the extended proportional change model to related models concludes the report.

INTRODUCTION

The impact of persuasive argumentation has been studied, with exceptions (Anderson, 1959; Hoffman and Maier, 1964), by measuring the attitude before confronting and after confronting the subject with the information in question. The usual way to test the difference between the various experimental conditions is an analysis of covariance, performed on the final preference scores and using the initial preference scores for covariate control. This approach, however, obviously prevents a deeper understanding of the persuasion process.

Being interested specifically in just that process a research group at the University of Augsburg designed a series of experiments on group discussion in which each participant in the discussion or observer of the discussion rated his attitude toward the discussed topic (decision alternative) continuously after each argument, thus generating a time series of preference.

The focus of interest was how emotional responses to the source of information affect the persuasion process. For this purpose the emotional response of the receiver of the message to the source of the message was varied experimentally either by making the subject believe his partner would have the same values or quite different ones, or by introducing a simulated partner, who answered the

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subject's arguments with a friendly remark or unfriendly one, before presenting the counterargument.

There are various methods of data analysis which take the whole set of repeated measures into account in some way or another. An analysis of variance of differences in trends can be applied if all variances and all correlations between the repeated measures are the same, i.e. if the variance–covariance matrices have compound symmetry (Winer, 1971, p. 533). However such is not the case with our data; as the length of time between the repeated measurements increases, the correlation decreases; further, the correlations are higher within the set of measures taken after the subject's own argument and within the set of measures taken after the opponent's arguments than are the correlations between the two sets of measurement.

To apply a multivariate analysis of variance to the set of repeated measures would be less objectionable, because it does not presuppose variance–covariance matrices with compound symmetry. Another choice would be to compute a correlation matrix over subjects for the whole set of repeated preference measures in order to determine the factor structure of this matrix; to calculate factor scores for each individual; and to apply multivariate analysis of variance on these factor scores. As the correlation matrix suggests (not shown here), four factors probably would have emerged: The preference measures taken after the early arguments loading high on one factor; the later ones loading high on a second factor; the preference scores after the subject's own arguments loading high on a third factor; and the preference scores after the opponent's arguments loading on a fourth factor. Obviously a multivariate analysis of variance of original repeated measures or of factor scores reveals more about the process of persuasion and how this process is modified by emotional responses than an analysis of the final scores alone.

A different approach was chosen by Schuler and Peltzer (1975). For each subject they calculated a nonparametric correlation coefficient, Kendall's τ, between the time order of arguments and the series of preference scores assessed immediately after each argument. The correlation coefficients indicate the degree to which a person was influenced by the series of arguments, and they have been used by Peltzer and Schuler as the dependent variable on which they applied an analysis of variance.

While these methods use the whole set of repeated measures, they deal only with global effects of the process. What is needed is a model representing the process itself.

THE PROCESS MODEL OF PROPORTIONAL CHANGE

Among the various possible ways of formalizing this process of attitude change, an extended proportional change model seems especially to be useful. The purpose of this article is to show that the proportional change model (French, 1956; Anderson and Hovland, 1957), extended by including the distance between initial position and position at time t, is theoretically sound and empirically valid as a model of influence process in group discussion.

The original proportional change model (French, 1956; Anderson and Hovland, 1957) assumed that the amount of change produced by an argument is proportional to the distance between the attitude expressed through the arguments, and the attitude held by the recipient of the message. This assumption may have been adequate for an experimental situation in which many people holding inter-individually varying attitudes were exposed to just one discrepant message. However, if there is a longer series of arguments making a person abandon his initial position and move step by step towards the arguments' position, the situation is different. Subjective experience of members of the research team, interviews of experimental subjects, as well as results of previously performed experiments suggested a modification of the proportional distance model by taking into account that the resistance to further change may increase with the distance from the initial position. To predict the process of attitude change, the extended form of the model adds to the message discrepancy the distance of a person's initial stand and his stand at time t.

$$\begin{aligned} x_t - x_{t+1} &= b_1(x_t - s_t) + b_2(x_t, x_{t+1}) \\ x_t, x_{t+1} &= \text{attitude at time } t \text{ resp. } t+1 \\ x_o &= \text{initial attitude} \\ s_t &= \text{scale value of the argument at time } t \\ b_1 b_2 &= \text{weights} \end{aligned} \quad (1)$$

For simplifying the notation we define

$$\begin{aligned} x_t - x_{t+1} &= Z \\ x_t - s_t &= X \\ x_t - x_o &= Y \end{aligned}$$

the model takes then the form

$$Z = b_1X + b_2Y$$

(For theoretical reasons the model does not allow for an additive constant.)

For a least square solution the following function has to be minimized.

$$(Z - b_1X - b_2Y)^2 = \min$$

A partial derivation results in the following equation for estimating the b-coefficients.

$$\begin{aligned} \Sigma XZ &= b_1\Sigma X^2 + b_1\Sigma XY \\ \Sigma YZ &= b_1\Sigma YX + b_2\Sigma Y^2 \end{aligned}$$

A numerical example may be helpful in clarifying the psychological interpretation of the model. Assuming an eleven point preference scale with 0 as the lowest score and with 10 the highest score, the process of attitude change of a subject exchanging pro-arguments and con-arguments with his partner may be represented as a sequence of numbers over the time series $t = 0$ (starting position) to $t = 8$ (final position). The subject generates pro-arguments; the partner offers con-arguments. For simplicity of representation it may be assumed that each of the subject's arguments has the scale value of 9; i.e., strongly in favour of the issue, while each of the opponent's arguments is assumed to have the scale value of 1.

Table 1. Example of a time series (t) with scale values of arguments (s_t), attitudes (x_t), and the difference variables $Z = x_t - x_{t+1}$, $X = x_t - s_t$, and $Y = x_t = x_o$

t	0	1	2	3	4	5	6	7	8
s_t		9	1	9	1	9	1	9	1
x_t	9	9	7	8	6	7	5	6	4
Z		0	2	–1	2	–1	2	–1	2
X		0	8	–2	7	–3	6	–4	5
Y		0	0	–2	–1	–3	–2	–4	3

t = time series; s = scale value of arguments; x = scale value of attitude; $Z = x_t - x_{t+1}$; $X = x_t - s_t$; $Y = x_t - x_o$.

The least square estimates of the parameters are in this case $b_1 = 0.300$ and $b_2 = 0.035$.
The Equation 1 can be transformed into

$$x_{t+1} = (1 - b_1)x_t + b_1 s_t - b_2(x_t - x_o)$$

From that it becomes clear that b_1 represents the average relative weight the subject puts on each argument in combining the scale value x_t of his preference at time t with the scale value s_t of the respective argument to form a new preference x_{t+1}. Since b_1 and b_2 are partial regression coefficients, this interpretation implies holding constant the distance from the initial position $x_t - x_o$. The higher b_1, the larger are the steps of the subject moving forward and backward, with larger steps resulting from the more distant argument. The parameter b_2 is a kind of elasticity coefficient; the product b_2 $(x_t - x_o)$ represents the forces that tend to pull the subject back to his initial position. The coefficient b_2 attenuates the effect of the opponent's argument and strengthens the effect of the subject's own arguments.

Exchanging pro-arguments and con-arguments each with constant scale value in a regular sequence must lead to an equilibrium state defined by (a) a specific equilibrium point somewhere between the person's initial position and the average scale value of the arguments, and (b) a span of oscillation around this point. The equilibrium point of an undefinitely long series of pro-arguments and con-arguments is equal to the average scale value of the arguments if the coefficient of resistance b_2 is zero. With b_1 increasing, the movement toward the equilibrium point becomes faster, and the oscillation span around this point becomes larger. With b_2 increasing, the equilibrium point is closer to the initial position of the subject. In terms of proportional changes within the equilibrium state, the relative width of the step forward is equal to the relative width of the step backward toward the initial position, is b_2 equals zero. As b_2 increases the proportional distance moved forward is smaller than the proportional distance moved backward.

In testing the validity of the model, all pro-arguments were set equal to 9, and all con-arguments were set equal to 1. However this does not exhaust the potential of the model. A still better fit of the model could be achieved either by (a) substituting these scale values by using empirically estimated values, or (b) weighting the arguments according to their persuasiveness.

HYPOTHESES ON THE EFFECT OF SOCIAL EMOTIONAL RESPONSES

The influence people exert on each other in discussion may be traced to three sources:

(1) Learning the other's stand on the issue elicits social comparison processes.
(2) Learning the other's demand prompts a subject to yield.
(3) Learning the other's arguments leads to a cognitive change.

Each partner's argument is a repeated signal of the partner's stand and demand; further the argument comprises information on the issue. Although social and emotional responses may affect all three components of the influence process, yielding to the other's demand (i.e., expressed desire to influence) and conforming to the other's stand probably will be affected most. To know the position of a liked or similar discussion partner usually is more relevant to a subject in finding the appropriate position on an issue and the demand is more acceptable, especially when values are at stake. Additionally, yielding to the other's demand is more probable when the partner is liked.

In our model the coefficient b_1 represents the combined influence of (a) information transmitted by the argument; (b) the perceived stand of the partner; and (c) the perceived demand. It was assumed that the coefficient b_1 will be higher with a similar partner than with a dissimilar one, mainly because a similar partner's stand is more relevant to the subject, and his demand is more acceptable (*hypothesis* 1). Further we assumed that the tendency to return to the initial position should increase with the distance from the initial position. This tendency is supposed to be measured by the coefficient b_2. It should be higher with a dissimilar partner than with a similar one (*hypothesis* 2). This hypothesis is based on the idea that a similar partner is more attractive and therefore better able to overcome the increasing resistance to further change, thus eventually leading the subject closer to the partner's position.

EXPERIMENTAL DESIGN

A series of experiments, performed at the Institute for Socioeconomics at the University of Augsburg, was aimed at explaining the impact of social emotions on the influence process of group discussions. What is reported here is based on a reanalysis of the data of two experiments by Schuler and Peltzer (1975) and Peltzer and Schuler (1976). Since the experiments were described in detail elsewhere, only the main features of the design will be presented here.

There were about 80 subjects, students of business administration and economics, in each of the two closely related experiments. We will present first the features that were common to both experiments, then point to the differences.

After reading a case study about a personnel decision problem which contained a mixture of positive judgements and negative judgements concerning a job applicant's skills, the subjects had to decide, individually, whether to accept or to reject the applicant for the position of a bank teller. A set of ten written arguments, some of which justified the decision he made while others took an indifferent position were then distributed to the subjects. Subsequently, a discussion with a fictitious partner holding a contrary position was opened via computer terminals by transmitting and receiving a series of arguments selected from the set of pro-to neutral arguments, or neutral to con-arguments. The subject's task was to rate his decision preference after considering the arguments one by one. Thus each subject created a series of preference ratings following the regularly alternating exchange of pro-arguments and con-arguments.

Since the model rests on the assumption that the preferences are measured on an interval scale, we may take a closer look at the instructions and scale format. The subjects were asked to estimate the implicit overall weight of arguments supporting their position relative to the overall weight of arguments opposing their own position, and to indicate their preference on an 11-point graphic scale extending from 0:100 to 100:0, with 50:50 corresponding to the indifference point dividing pro-attitude from con-attitude. This instruction should prompt the subjects to consider carefully the pro-arguments and con-arguments while scaling their preferences. Although there were some persistent doubts concerning the level of measurement of this scale, we used it in all of our experiments in order to obtain comparable results.

Obviously, the graphic intervals do not correspond to the number ratios. Therefore, the subjects may have experienced some conflict concerning whether to use the graphic interval scale or the numerical ratio scale. If they really were able and willing to form a ratio of weights and to indicate this ratio on the scale, disregarding the graphic intervals, we were not able to rely on the graphic scale values in analyzing the preference change. Corresponding to a model that in psychophysics has proven useful (Stevens, 1975), an appropriate preference interval scale would have been

$$\ln \frac{X}{100-X} \text{ rather than } \frac{X}{100-X} \text{ or } X;\ 0< X < 100.$$

That we were right to base most of our data analyses on the graphic scale recently has been confirmed by Stehle (1977). He compared the scale of Figure 1 with a verbally anchored graphic scale finding them essentially equivalent. So we may assume that the graphic scale used here is a kind of interval scale.

The three factors of the experiment 1 (Peltzer and Schuler 1976) were similarity of the partner (manipulated by feeding back to the subject a value profile that was similar or dissimilar to his own); friendliness of the partner (a partner introducing most of his arguments with friendly or unfriendly remarks); and the order of arguments (the discussion opened by subject or partner).

Experiment 2 (Schuler and Peltzer, 1975) was designed to test the $2 \times 2 \times 2$ combination of the partner's similarity, the partner's competence (a partner allegedly having reached a higher or lower score than the subject on a person perception test), and the expectation of a personal encounter in the near future.

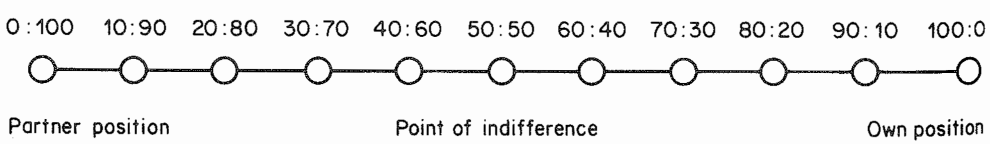

Figure 1 Rating scale

We will restrict the reanalysis of the data to the main effect of similarity, which is common to both of the experiments. The questionnaire used for manipulating perceived similarity asked for attitudes towards central values not related to the decision problem. The effect on the partner's attractiveness proved to be rather strong.

RESULTS

The hypotheses were tested by estimating the parameters of the model for each experimental condition and performing an analysis of variance with coefficients b_1 and b_2 as the dependent variables and with experimental conditions as the independent variable. As the within class correlations between b_1 and b_2 were close to zero in both experiments, we were able to apply separate univariate analyses of variance to b_1 and b_2.

It was necessary to exclude from the analysis 16 subjects (7 in the first experiment, and 9 in the second experiment) whose parameters b_1 and b_2 could not be estimated because their attitudes did not change. Also excluded were four subjects (two in each experiment) whose b_1-coefficients were more than 3.5 standard deviations from the mean value. They might have misunderstood the instruction rating the convincingness of the arguments instead of indicating their decision preferences. Three subjects (two in the first experiment and one in the second) actually moved away steadily from their partner's position, although the estimates of the b_1-coefficients turned out to be positive. The mean square of differences between empirical values and values estimated by the model was extremely high in these cases.

Analyses of three levels of aggregation were performed on individual preference series (aggregation level 1); on averaged preference series of randomly selected dyads sharing the same initial position (aggregation level 2); and on averaged preference series of all subjects sharing the same initial position (aggregation level 3). Such an averaging procedure was meant to reduce the error variance, although we were aware of possible systematic individual differences in responding to the pro-arguments and con-arguments. By comparing the three levels of aggregation we also may obtain some information about that problem.

The results for individual cases (aggregation level 1) are presented first; those for the averaged curves of dyads (aggregation level 2) are presented second; and those

Table 2. Subjects in experiment 1 and experiment 2

(a) Experiment 1	A	B	C	D	(b) Experiment 2	A	B	C	D
Similar	35	4	1	0	Similar	33	7	1	0
Dissimilar	34	3	1	2	Dissimilar	36	2	1	1

A: Number of reanalysed cases; B: Number of subjects without attitude change;
C: Number of subjects whose b_1-coefficient is more than 3.5 standard deviations above the mean;
D: Number of subjects who steadily moved away from the partner's position showing an extremely poor fit of the data to the model.

for the averaged curve of all persons having the same initial position (aggregation level 3) are presented third.

Analysis of data on aggregation level 1

Both F-ratios were not significant, but performing a 2 × 2 (experiment by similarity) unweighted means analysis of variance resulted in a significant main effect for similarity ($F_{1,136} = 3{,}71; p < 0.05$, one-tailed). The sum of squares due to differences between experiments and experiment by similarity interaction was negligibly

Table 3. Means and standard deviations of b_1

(a) Experiment 1	n	$\bar{x}$	s	(b) Experiment 2	n	$\bar{x}$	s
Similar	35	0.0752	0.0855	Similar	33	0.0693	0.0538
Dissimilar	34	0.0516	0.0510	Dissimilar	36	0.0503	0.0652

Table 4. Analysis of variance with b_1 as dependent variable

(a) Experiment 1	SS	df	MS	F	(b) Experiment 2	SS	df	MS	F
Similarity	0.0096	1	0.0096	1.92	Similarity	0.0063	1	0.0063	1.74
Error	0.3345	67	0.0050		Error	0.2413	67	0.0036	

Table 5. Means and standard deviations of b_2

(a) Experiment 1	n	$\bar{x}$	s	(b) Experiment 2	n	$\bar{x}$	s
Similar	35	0.458	0.360	Similar	33	0.412	0.373
Dissimilar	34	0.370	0.362	Dissimilar	36	0.413	0.394

low, so it was combined with the error sum of squares. As predicted (hypothesis 1) the coefficient b_1 is higher with a similar partner than with a dissimilar one. The magnitude of the effect is rather low, since only 2 per cent of the variance ($\hat{\omega}^2 = 0.02$) are explained by similarity (Winer, 1971, S. 429).

Hypothesis 2 obviously has not been confirmed.

Analysis of data of aggregation level 2

Within each treatment combination (initial position × similarity × experiment) the subjects were grouped randomly into dyads, if there were an even number of subjects, or into dyads and one triad, if the number were odd. For each dyad or triad the series of preference scores were averaged. The two experiments had to be combined in a 2 × 2 analysis of variance (initial position × similarity), in order to have at least two observations in each cell.

Table 6(a). Means and standard deviations of b_1 for averaged curves of randomly selected dyads showing the same initial position: both experiments combined

Similar: Initial position	n (dyads)	$\bar{X}$	s	Dissimilar: Initial position	n (dyads)	$\bar{X}$	s	Row means
9	4	0.081	0.046	9	6	0.068	0.025	0.075
8	16	0.072	0.052	8	9	0.052	0.068	0.062
7	8	0.081	0.055	7	7	0.047	0.043	0.064
6	3	0.054	0.019	6	6	0.039	0.023	0.047
Column means		0.072				0.052		

Table 6(b). Analysis of variance: similarity and initial position as independent and b_1 as dependent variable: both experiments combined

	SS	df	MS	F	
Similarity (A)	0.0050	1	0.0050	2.17	n.s.
Initial position (B)	0.0047	3	0.0016		
A × B	0.0008	3	0.0003		
Error	0.1240	51	0.0024		
Error revised	0.1295	57	0.0023		

Looking at the Tables 6(a) and 6(b) it can be seen that the subject's initial position had no influence at all on the b_1-coefficient; also there is no interaction between similarity and initial position. The effect of similarity was not significant, but one may notice that for every initial position the average value of b_1 was higher with a similar partner than with a dissimilar one.

As shown in Table 7 and contrary to hypotheses 2, there was also a tendency to higher b_2-coefficients with a similar partner than with a dissimilar one.

Table 7. Means and standard deviations of b_2 for averaged curves of randomly selected dyads sharing the same initial position: both experiments combined

Similar: Initial position	n (dyads)	$\bar{X}$	s	Dissimilar: Initial position	n (dyads)	$\bar{X}$	s	Row means
9	4	0.174	0.162	9	6	0.214	0.139	0.194
8	16	0.362	0.344	8	9	0.372	0.407	0.367
7	8	0.671	0.405	7	7	0.204	0.210	0.438
6	3	0.234	0.128	6	6	0.281	0.174	0.258
Column means		0.360				0.268		

Analysis of data on aggregation level 3

On this aggregation level the preference series of all subjects sharing the same initial position within an experiment were averaged. Only those initial positions which existed in both experimental conditions (similar and dissimilar) were taken into consideration. This did not apply to extreme initial positions or to indifferent ones. That is the reason for the different number of analysed cases in Tables 4 and 5 as compared to Table 8. The number of subjects on which the average was taken varied from three to 16. For each averaged series of preferences the coefficients b_1 and b_2 were calculated (*cf.* Table 8).

Table 8. Averaged curves of all subjects sharing the same initial position

	Experiment 1							Experiment 2					
	Similar			Dissimilar				Similar			Dissimilar		
Initial	n	b_1	b_2	n	b_1	b_2	Initial	n	b_1	b_2	n	b_1	b_2
9	5	0.045	0.221	4	0.076	0.147	9	4	0.114	0.093	9	0.065	0.224
8	16	0.076	0.421	7	0.063	0.085	8	16	0.082	0.299	13	0.062	0.516
7	11	0.134	0.464	7	0.058	0.332	7	7	0.052	0.853	9	0.035	0.207
6	3	0.051	0.274	10	0.040	0.345	6	5	0.059	0.244	3	0.036	0.265

In seven conditions out of eight the b_1-coefficient was higher with a similar partner than with a dissimilar one (the one-tailed probability under H_0 is for the binomial test $p < 0.035$). The *t*-test for correlated observations (pairs matched according to initial position and experimental design) also was significant, (one-tailed, $p < 0.05$). Corresponding to the results with individual cases and dyad averages, there was no significant difference in the b_2-coefficient.

Comparison of the modified proportional change model with alternative models

The modified proportional change model (hence called model 3), was chosen for theoretical reasons. Does it fit the data at least as well as a simpler but theoretically less meaningful model, that may be called model 2?

$$x_t x_{t+1} = b(x_t - s_t) + a$$

The parameters of this model were estimated from the data on aggregation level 3 only (Tables 8 and 9).

Table 9. Parameters a and b of model 2 in experiment 1; aggregation level 3.

Initial position	Similar n	Similar b	Dissimilar n	Dissimilar b	Similar n	Similar a	Dissimilar n	Dissimilar a
9	5	0.043	4	0.071	5	−0.065	4	−0.052
8	16	0.095	7	0.058	16	−0.178	7	−0.008
7	11	0.163	7	0.072	11	−0.158	7	−0.070
6	3	0.057	10	0.050	3	−0.017	10	−0.050

n, number of aggregated processes

Table 10. Parameters a and b of model 2 in experiment 2; aggregation level 3

Initial position	Similar n	Similar b	Dissimilar n	Dissimilar b	Similar n	Similar a	Dissimilar n	Dissimilar a
9	4	0.120	9	0.075	4	−0.096	9	−0.154
8	16	0.097	13	0.071	16	−0.176	13	−0.144
7	7	0.130	9	0.036	7	−0.250	9	−0.012
6	5	0.064	3	0.035	5	−0.002	3	0.038

n, number of aggregated processes

Again as in model 3 the parameter b_1 was higher in seven conditions out of eight with a similar partner than with a dissimilar one. Contrary to what was expected, the parameter a was lower in six conditions.

It was also of some interest to see how the simple proportional change model (called model 1)

$$x_t - x_{t+1} = b(x_t - s_t)$$

compared with model 3.

It was not surprising that the respective b-parameters of models 1 and 2 were of about the same size and differentiate in the same way between the similar–dissimilar conditions. However, a closer look at the goodness of fit of these models reveals some differences.

In order to compare the goodness of fit of the models, the estimated parameters of the three models were used in predicting the sequence of preferences, beginning with the initial position, but without taking into account the further empirical preference scores. The residual sum of squares was used as measure for goodness of fit. Table 12 presents this measure for each of the experimental conditions.

Table 11. Parameter b of model 1 in experiment 1 and 2

Experiment 1 Initial position	Similar	Dissimilar	Experiment 2 Initial position	Similar	Dissimilar
9	0.035	0.065	9	0.109	0.055
8	0.077	0.058	8	0.078	0.055
7	0.155	0.066	7	0.107	0.035
6	0.057	0.049	6	0.064	0.037

The usual *F*-test for significance of a variable added to a regression equation was not applicable here, since the measures taken at time t were correlated with the measures taken at times $t+1$, $t+2$, etc. We know of no other significance test which could be applied here. The residual sums of squares therefore are purely descriptive. In addition to the numerical comparison of the parameters and the residual sum of squares of the three models the averaged time series of preferences estimated by the three models may be displayed graphically (Figure 2a, b).

Table 12. Residual sum of squares for each experiment and model

	Experiment 1							Experiment 2					
	Similar			Dissimilar				Similar			Dissimilar		
I.P.	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	I.P.	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
9	0.327	0.351	0.179	0.945	0.901	0.724	9	5.080	3.378	4.135	1.668	0.415	0.450
8	3.209	0.272	0.054	0.872	0.800	0.999	8	2.596	0.399	0.347	1.951	0.718	0.620
7	3.628	1.197	0.561	0.974	0.144	0.197	7	9.639	0.615	1.124	0.323	0.205	0.202
6	1.131	1.205	0.997	0.617	0.694	0.612	6	0.230	0.240	0.336	0.488	0.363	0.735
Sum	8.295	3.025	1.791	3.408	2.536	2.532	Sum	17.518	4.632	5.942	4.430	1.701	2.007

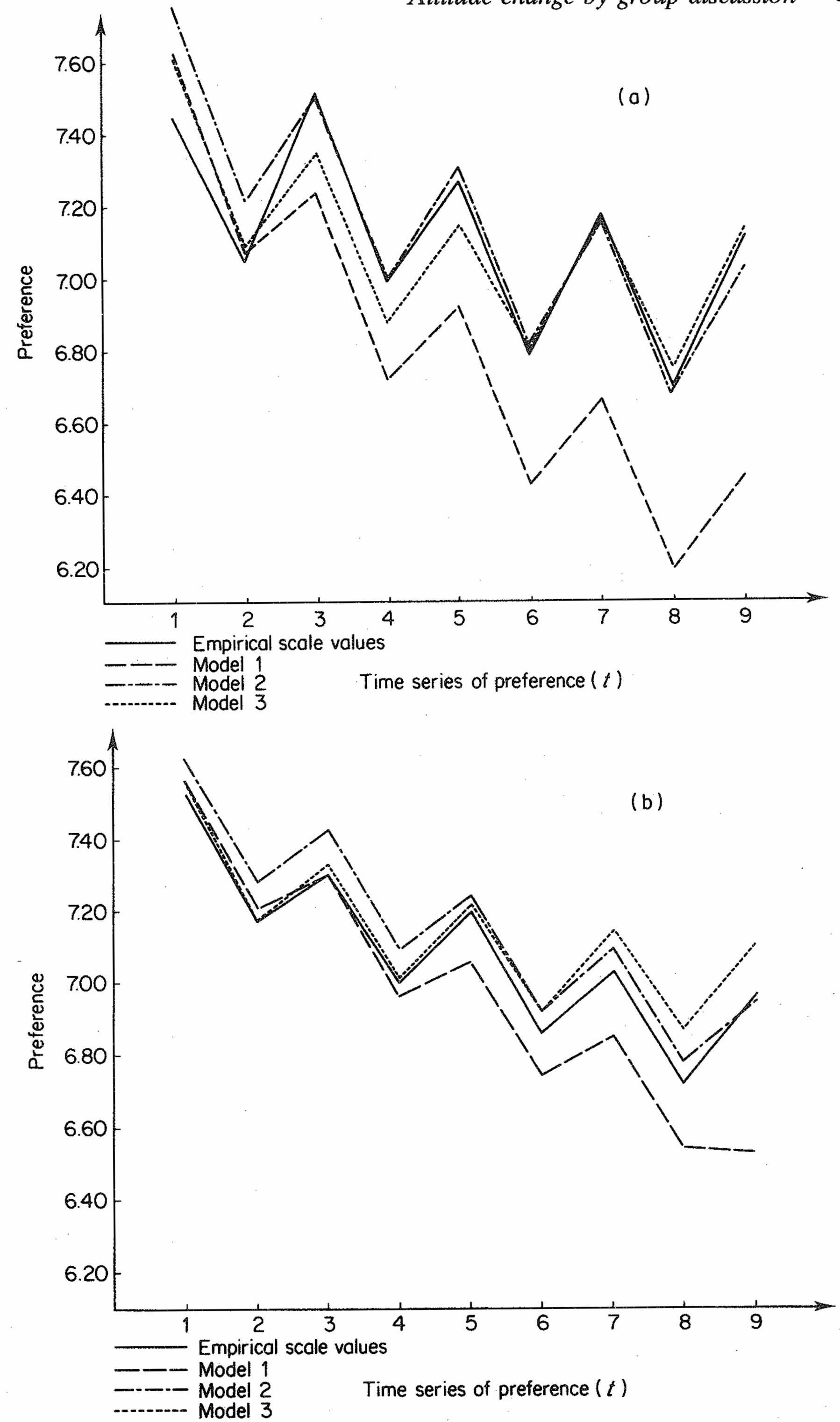

Figure 2(a) Comparison of goodness of fit of the three models based on data of the aggregation level 3: experimental condition 'similar'. The aggregated time series of preference were averaged over the four initial positions and the two experiments. (b) Comparison of goodness of fit of the three models based on data of the aggregation level 3: experimental condition 'dissimilar'. The aggregated

DISCUSSION

First a discussion of the results with comments on the comparison of the various models is presented, followed by an interpretation of the results of model 3.

Generally, models 2 and 3 seem to be superior to model 1. However, adding a parameter always improves the models fit to the data sample, even if there is no better fit to the data population. Although there is no way of testing the significance of the difference, it may be assumed that the improvement in goodness of fit from model 1 to model 2 and model 3 exceeded this chance effect. The obvious reason for the better fit of the models 2 and 3, compared to the model 1, is the fact that the former allow for some kind of accentuation of one alternative or the other. This becomes evident by rewriting the models in the following form:

model 1: $x_{t+1} = (1 - b)x_t + bs_t$

model 2: $x_{t+1} = (1 - b)x_t + bs_t - a$

model 3: $x_{t+1} = (1 - b_1 - b_2)x_t + b_1 s_t + b_2 x_o$

The possibility of stressing one side (with the additive constant a, is a feature of model 2. A similar feature is found in model 3 with the term, $b_2 x_o$, which also is an additive constant for each individual sequence of preferences. In addition model 3 has an affinity to the information integration models (Anderson, 1971; Anderson and Graesser, 1976). This becomes clear if we define

$$0 < b_1 < 1; \quad 0 < b_2 < 1; \quad 0 < b_1 + b_2 < 1$$

x_{t+1} is then a weighted average of x_t, s_t, and x_o. Actually all coefficients of the aggregation level 3 (Table 8) and most of those of aggregation level 2 and 1 (the means and standard deviation of the coefficients are shown in Tables 3, 5, 6, and 7) conform to these restrictions. But there remains a difference in the common averaging models, that is, the separation of x_t and x_o. A strict averaging process model would be what we may call model 4

$$x_{t+1} = \left(w_o x_o + \sum_{i=t}^{t} w_i s_i\right) \Big/ \left(w_o + \sum_{i=t}^{t} w_i\right)$$

w_o weight of initial preference
x_o initial preference
x_{t+1} preference at time $t + 1$
w_i weight of the argument i
s_i scale value of the argument i
t time series

It is the separation of x_t from x_o in model 3, which gives rise to the elasticity effect that is not present in model 4. Model 2 with its additive constant, a, does not represent an averaging process of information integration. Looking for a psychological interpretation of the constant, a, one could think of a plus or minus (depending on the sign of a) that is given to the partner for some reason, e.g., for his pleasant–unpleasant appearance or behaviour, or for the global attractiveness or popularity of his stand on the issue. One could relate independent measures of these variables to the coefficients, a, in order to test the validity of such an interpretation, if one would be interested in analyzing this model in greater detail.

We take now a closer look at the fit of model 3. As shown in Table 2, the model was applicable in 138 cases out of 160. One especially would like to know how the three subjects in the condition 'dissimilar partner' who steadily moved away from the opponent's position (group D in Table 2) perceived the experimental situation. We may speculate that these subjects disliked their opponent so much that perceiving his stand and his demand prompted them to increase their distance from his position. If this were so, it would contradict the model, according to which change in both directions must be proportional to the distance of the subject's position, to the partner's, or to the subject's own argument, if the distance from the subject's present position to the subject's initial position $(s_t - x_t)$ is neglected.

An inspection of preference sequences on aggregation level 1 (individual cases) suggests that with some subjects the proportional change toward the position of the partner's arguments is different from the proportional change toward the position of the subject's own argument. The model's fit is poor in these cases. On the higher aggregation levels this difficulty disappears: pro-arguments and con-arguments elicit about the same proportional change.

There are nine cases with a negative b_1-coefficient (two with a similar partner and seven with a dissimilar partner). These subjects obviously did not integrate the information of the arguments; rather, they answered the demand of the argument by a counter-reaction. The problem with these nine cases is not a poor fit to the model; actually on the average the residuals are not higher than those of the cases that show a positive b_1-coefficient. It is rather the apparent absence of information integration that bothers us. Assuming that the influence of issue information would outweigh possible tendencies to withdraw from a dissimilar opponent we had expected smaller but nevertheless positive b_1-coefficient in the dissimilar condition than in the similar one. It was this theoretical reasoning as well as a preference for simplicity that made us choose such a model. What is the meaning of a negative b_1-coefficient? Since the b_1-coefficient is the same for the distances in both directions, this kind of 'boomerang-effect' would follow the opponent's argument as well as the own argument. For all subjects in a position below 9 this would mean an alternating sequence of a rather big step away from the opponent's position following his argument and a small step back toward the own initial position following the own argument although the latter is assumed to be more extreme than the initial position. Consequently at the end of the discussion the subject's position is more extreme than at the beginning. An inspection of the averaged curve of the nine cases showing a negative b_1-coefficient (not presented in the paper) suggests this interpretation: if a person answers the opponent's argument with a counter-reaction he tends to return to his initial position after the next own argument.

Another problem occured with those 13 subjects whose data give rise to a negative b_2-coefficient. Contrary to the prediction, the resistance to further change decreased as the distance of the subject's position at time t relative to his initial position increased. Why does the behaviour of these subjects contradict the theory? In future experiments an extensive postexperimental interview could provide some hints about how to explain these individual differences.

The psychological interpretation of b_2 as a force pulling the subject back to the initial position is also open to question. It is necessary to measure this tendency more directly. The increasing resistance to further change in the direction of the opponent's position could be explained in several ways:

(1) The later arguments of the opponent are less convincing, (a) because they repeat information that already was comprised, at least in part, by the antecedent arguments; or (b) because the opponent selects the stronger arguments at the beginning of the discussion, leaving the weaker ones for the end.

(2) The opponent, arguing stubbornly against the subject's position, increasingly is devalued; as a consequence, the subject increasingly becomes resistant to the opponent's demand. This may be true mainly with a similar partner, whose stubborness seems especially to be frustrating to some of the subjects, as the changes from initial to final liking rating (not shown here) suggest. Actually, in the first experiment the b_2-coefficients tended to be higher with a similar partner than with a dissimilar one. In this experiment the effect of partner similarity was combined with partner friendliness. A similar but unfriendly partner persistently opposing the subject's view may be assumed to be especially disappointing to the subject. There are some hints in the data (not presented here) which support this *post hoc* hypothesis.

Summarizing the results of data analysis on aggregation level 1 we nevertheless can say that most of the individual preference-curves were represented by the model in an acceptable manner. When the discrepancy between estimated curve and empirical curve is large, the kind of deviation gives reference to potential explanations and further modifications of the model.

The analysis on aggregation levels 2 and 3 did not give much additional information. As expected, the averaged time series of preferences conformed well to the theory. On aggregation level 2 there were only three preference curves with negative b_1-coefficients, all in the condition 'dissimilar partner'.

It may well be that the model's validity is restricted to discussions dealing with topics that are not heavily loaded with value preferences, and where emotional reactions therefore are rather weak. In the case of a controversy on central values integrating information on the issue probably will be less salient than comparing the own position with the other's stand and reacting to his demand. The limits of the model will be tested by applying it to other kinds of decision problems.

Although the influence of partner similarity on the sequence of preferences was described more precisely by the extended proportional change model than by analysis of variance of global effects, there are, nevertheless, a lot of questions referring to the psychological interpretation of the change model and its implications which must be answered by future research. One way to a better understanding of the model will be to clarify the theoretical concepts and to develop valid measures of these explanatory concepts. This will be a difficult task, even if we restrict our search to the question of how social emotional responses modify the influence process in a group discussion.

What we need is to separate the different modes by which social emotional responses affect the perception of the other's stand, the other's demand, and the integration of the other's information on the issue transmitted by his arguments.

Including a separate parameter for the opponent's attractiveness probably would improve the model's fit especially to those change processes than cannot be explained by concepts of information integration. Such a parameter could more clearly indicate how attractiveness affects the relevance of the other's stand for social comparison and the readiness to give in to his demand, besides the influence of information integration. The extended model could be formalized in the following way

$$x_t - x_{t+1} = b_1(x_t - s_t) + b_2(x_t - x_o) + b_3 v_t$$

The variables x_o, x_t, and s_t are defined as in model 3. In addition to these variables v_t is to indicate the emotional value of the speaker at time t.

Looking for further theoretical clarification of the process of attitude change by group discussion, one may also reconsider the concepts and statements of the social judgment theory (Sherif and Hovland, 1961).

Referring to this theory, Whittaker (1967), assumed and presented some empirical evidence that the relation between communication discrepancy and the amount of change generated by the communication can be presented by an inverted U-shaped function, the amount of change first increasing, then decreasing with message discrepancy. We did not find such a function in our data. There was no main effect of extremity on the parameters of model 3 (*cf.* Tables 6 and 7). The data supported the prediction of proportional change. This means that the amount of change in absolute terms increased with message discrepancy. The theory behind this assumption has been criticized for the ambiguity of its central concepts, i.e., the latitude of acceptance, the latitude of rejection, and ego involvement (Rüttinger, 1974, 102–111; Irle, 1975, 288–294). Nevertheless, it may be worthwhile to include improved measures of these concepts in the future research.

Several experiments by Zaleska (1978) showed that subjects participating in an unrestricted group discussion were especially resistant to changing their position, if this position had a high frequency in the population in which the subjects belonged. It would be interesting to know whether this is also true if the discussion is restricted to an equal number of pro-arguments and con-arguments, the way our experiments were constructed. The extended proportional change model also is expected to be sensitive in testing such a hypothesis.

REFERENCES

Anderson, N. H. and Hovland, C. J. (1957). 'The representation of order effects in communication research.' *In* Hovland, C. J. (Ed.), *The Order of Presentation in Persuasion*, Yale University Press, New Haven and London.

Anderson, N. (1959). 'Test of a model for opinion change', *Journal of Abnormal and Social Psychology*, **59**: 371–381.

Anderson, N. H. (1971). 'Integration theory and attitude change', *Psychological Review*, **78**: 171–206.

Anderson, N. H. and Graesser, C. C. (1976). 'An information integration analysis at attitude change in group discussion,' *Journal of Personality and Social Psychology*, **34**: 210–222.

French, J. R. P. Jr. (1956). 'A formal theory of social power', *Psychological Review*, **63**: 181–194.

Hoffman, L. R. and Maier, N. R. F. (1964). 'Valence in the adaption of solutions by problems solving groups: concept, method and results', *Journal of Abnormal Social Psychology*, **69**: 264–271.

Irle, M. (1975). *Lehrbuch der Sozialpsychologie*, Hogrefe, Göttingen.

Peltzer, U. and Schuler, H. (1976). 'Personwahrnehmung, Diskussions-verhalten und Präferenzänderung in Dyaden (LIDIA II).' In: Brandstätter, H. and Schuler, H. (Eds.), *Entscheidungsprozesse in Gruppen, Zeitschrift fur Sozialpsychologie,* **2**: 105–117.

Rüttinger, B. (1974). 'Die Wirkung verbaler Aggression auf den Sprechereinfluß und den Sprechereindruck in Entscheidungsgruppen', *Dissertation*, Universität Augsburg.

Schuler, H. and Peltzer, U. (1975). Ähnlichkeit, Kompetenz und die Erwartung künftiger Interaktion als Determinanten von Diskussionsverhalten und Partnerbeurteilung (LIDIA III).' In: *Problem und Entscheidung*, papers for organizational psychology of the Institute of Psychology of the University München and the section psychology of the University Augsburg, **14**: 78–109.

Sherif, M. and Hovland, C. I. (1961). *Social Judgement*, Yale University Press, New Haven.

Stehle, W. (1977). 'Die Skalierung von Entscheidungspräferenzen. Ein experimenteller Skalenvergleich.' Unveröffentl. Diplomarbeit Universität Augsburg.

Stevens, S. S. (1975). *Psychophysics,* Wiley, New York.

Whittaker, J. O. (1967). 'Resolution of the communication discrepancy issue in attitude change.' *In* Sherif, C. W. (Ed.), *Attitude, Ego-involvement and Change,* Wiley. New York.

Winer, B. J. (1971). *Statistical Principles in Experimental Design,* McGraw-Hill, New York.

Zaleska, M. (March 1978). 'Extremity of opinion and opinion change', paper presented at the general Meeting of the Association of Experimental Social Psychology in Weimar.

RÉSUMÉ

On a réanalysé les données de deux expériences de discussions de groupes à deux. On a élaboré un modèle plus général de changement proportionnel pour rendre compte des processus réels de changement d'attitude (changement proportionnel: le changement est fonction de l'écart entre les attitudes; le modèle est plus général en ceci qu'il tient compte de la distance entre la position initiale et la position au temps t). Le modèle est défini par deux paramètres. Le premier représente l'effet des différents arguments favorables et des différents arguments défavorables sur l'attitude ou la préférence quant à la décision. Le second décrit la résistance à un changement plus prononcé, résistance qui croit avec la distance à la position initiale. On avait fait l'hypothèse que le premier paramètre serait plus élevé pour un partenaire semblable que pour un partenaire différent et que l'inverse serait vrai pour le deuxième paramètre. La prédiction a été confirmée seulement pour le premier paramètre. On conclut l'article par une comparaison entre le modèle présenté ici et d'autres modèles du même type.

ZUSAMMENFASSUNG

Die Daten zweier Experimente zur Gruppendiskussion (Dyaden) werden reanalysiert. Zur Erklärung des Prozesses der Einstellungsänderung wurde ein modifiziertes proportionales Distanzmodell entworfen. Dieses Distanzmodell ist durch zwei Parameter definiert. Der eine repräsentiert die Wirkung der einzelnen Pro- und Contra-Argumente auf die Entscheidungspräferenz. Der andere Parameter beschreibt den Widerstand gegen weitere Einstellungsänderungen, der mit der Distanz zur anfänglichen Entscheidungspräferenz wächst. Es wurde vermutet, daß der erste Parameter bei einem ähnlichen Diskussionspartner höher und der zweite niedriger sein würde als bei einem unähnlichen Diskussionspartner. Diese Vermutung ließ sich nur für den ersten Parameter bestätigen. Abschließend wird das modifizierte portionale Distanzmodell mit Modell-Alternativen verglichen.

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Behavioural style and group cohesiveness as sources of minority influence*

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Abstract

Behavioural style and group cohesiveness were tested as sources of minority influence under conditions in which rejection of the minority from the group was possible and under conditions in which it was not. Female subjects (N = 120) were led to believe that they were interacting as a group and that they held a majority position on a relevant issue. The influence agent, ostensibly one of the group members, advocated a minority position throughout their interaction. Three variables were manipulated: group cohesiveness (high or low), behavioural style of the deviate (high or low consistency) and opportunity for rejection of the deviate from the group (possible or not possible). It was predicted that the deviate would be more influential under high cohesive than under low cohesive conditions and that she would be most influential when she was highly consistent and there was no opportunity to reject her. Although both hypotheses were confirmed, unexpected minority influence effects were also found.

INTRODUCTION

Social influence research has been focused almost exclusively on one form of influence—conformity, the influence of the group on the individual and the majority on the minority (cf. Allen, 1965). Recent research on innovation, however, has turned the conformity question around and asked how individuals and active minorities can influence the majority (Moscovici, 1976; Moscovici and Faucheux, 1972; Moscovici and Nemeth, 1974). This new research has called into question previous models of social influence processes because they are seemingly unable to account for influence produced by relatively powerless minorities. By considering the minority influence research in light of traditional explanations of

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