CHAPTER 12

Belief Change and Accumulated Information

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INTRODUCTION

Many theorists argue that "established" beliefs are more difficult to change than de novo beliefs [Cantril (1946), Anderson and Hovland (1957), Roberts (1972), Hovland (1972), and Saltiel and Woelfel (1975)]. Two theories have been advanced to explain such a finding. Cantril (1946) argues for a polarity effect, that is, the more extreme the belief, the greater its resistance to change. Hovland (1972) and Anderson and Hovland (1957) argue that the greater resistance to change stems from the greater amount of information that people have for established beliefs. This argument follows from information processing theory if we assume that people with more information spend more of the message time attending to internal counterarguments.

This chapter reports a study done to test these hypotheses: Are established beliefs more difficult to change? If so, is the increased resistance due to polarity effects or due to accumulated information?

We begin by developing models of change incorporating polarity and information effects in the information processing model of belief change. We could derive similar models from other attitude change theories but the literature on belief change has consistently confirmed discrepancy theory. Our data also show linear discrepancy functions, hence we do not formalize the other theories.

POLARITY

If there are no polarity effects, then the information processing model of belief change is a discrepancy equation. We shall consider only the basic linear model

$$\Delta b = \alpha(m - b),$$

where the message value m is one if the message argues for true and zero if the message argues for false.

Because the midpoint for certainty is .50 for subjective probability, polarity is the distance from .50 rather than the distance from zero, that is,

$$\text{polarity} = |b - .50|$$

Change is reduced from that predicted by the simple discrepancy model to the extent of polarity in the belief. The word "reduced" in this sentence means "reduced in absolute value" and hence the reduction is multiplicative rather than additive. Thus we represent the reduction mathematically by dividing by a number greater than one. The simplest divisor would be

$$\text{divisor} = 1 + \beta\text{polarity} = 1 + \beta|b - .50|$$

Thus the simplest polarity model of belief change is

$$\Delta b = \frac{\alpha(m - b)}{1 + \beta|b - .5|}$$

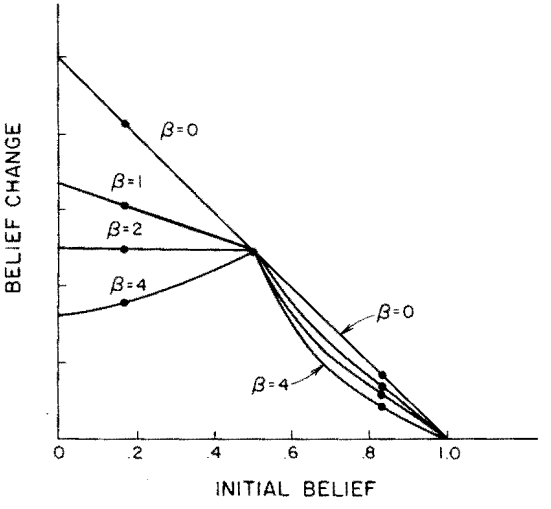

Fig. 12.1. The predicted relationship between belief change and initial belief for the information processing model with polarity effect (message argues for true) for four different values of the parameter β.

Parameter β measures the strength of the polarity effect. If $\beta = 0$, then there is no polarity effect, and the polarity model reduces to the simple linear discrepancy model.

The polarity model is plotted in Fig. 12.1 for various values of β under the assumption that the message argues for true. Polarity effects will be much larger at extremely discrepant initial beliefs than for beliefs already in the direction of the message. The large dots on each curve are plotted for reference to empirical data plots. If the belief range is split into three regions (.00–.35, .35–.65, and .65–1.00), then the corresponding average belief values would be .17, .50, and .83, respectively. If these three points are considered in isolation, then the qualitative prediction of the polarity model is that the points are concave downward, that is, the middle point lies above the straight line connecting the upper and lower points.

ACCUMULATED INFORMATION

Information processing theory predicts that belief change will be reduced to the extent that the receiver attends to internal counterarguments rather than the external message (Roberts and Maccoby, 1973). If people with more information about the belief topic are more likely to generate counterarguments than people with little information, then belief change should reduce to the extent of accumulated information.

If there were no accumulated information, then the belief change will be given by the linear discrepancy equation

$$\Delta b = \alpha(m - b).$$

Belief change will be reduced to the extent that the receiver attends to counterarguments. The presence of counterarguments is assumed to be a function of the amount of accumulated information. Therefore, belief change is reduced to the extent of such information. Because "reduced" here means "reduced in absolute value," the reduction is multiplicative rather than additive. Thus we divide the predicted belief change by a factor greater than one. The simplest such divisor is

$$\text{divisor} = 1 + \lambda I,$$

where I is the amount of information.

Figure 12.2 shows the predicted relationship between initial belief and belief change for the accumulated information model. The figure assumes that the data have been broken into subgroups with different amounts of prior information on the belief topic. That is, the data show all three curves, one for each information subgroup. The three large dots on each curve represent the values for the belief subgroups, that is, $b = .17, .50$, and .83, respectively.

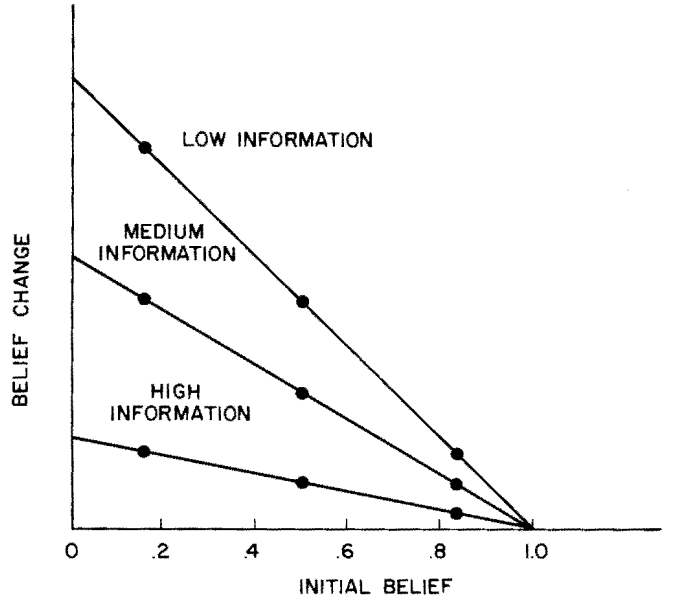

Fig. 12.2. The predicted relationship between initial belief and belief change for different amounts of accumulated information according to information processing theory (message argues for true).

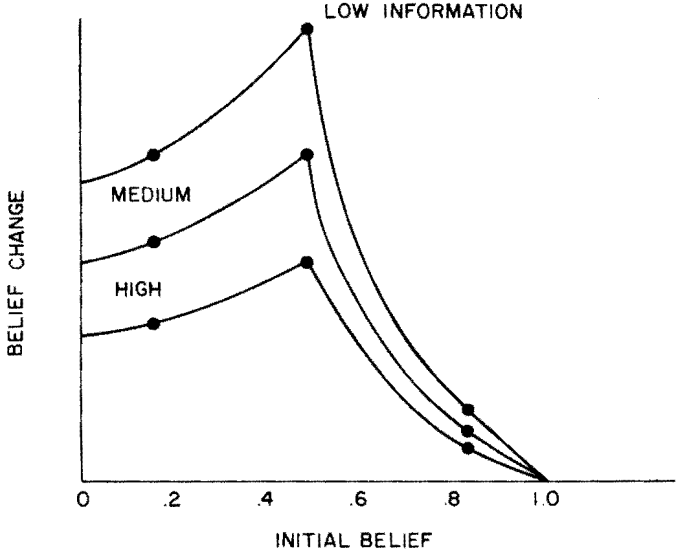

Fig. 12.3. The predicted relationship between initial belief and belief change for the hybrid information polarity model for $\beta = 4$ and a message that argues for true.

HYBRID MODEL

The polarity and accumulated information effects explanations are not logically contradictory. Thus both effects could occur. The "hybrid" model is obtained by dividing the linear discrepancy equation by both the polarity factor and the information factor. This hybrid model is

$$\Delta b = \frac{\alpha(m - b)}{(1 + \beta|b - .5|)(1 + \lambda I)}.$$

Figure 12.3 shows the predicted curves of the hybrid model for $\beta = 4$. The curves for each information subgroup all have the same shape because the value of β is the same for all curves. The curve for each subgroup is concave downward.

EMPIRICAL STUDY

Design

A study was run to test the information processing model and to see if established beliefs are more resistant to change than nonestablished beliefs. The study was a conventional pre–post attitude change study replicated across two belief topics. Prior information was measured in two ways: first, subjects were asked four items to assess their perception as to their state of knowledge; second, subjects were asked four questions as to the number of messages to on the topic to which they had been exposed. The first measure is referred to as the confidence measure of information and the second as the count measure of information. The plan was to break down the data by initial belief and information and compare the regression of belief change with that predicted by the various models.

Message-Belief Topics

The following belief statements were used for the experiment: (i) the nuclear production of electricity is potentially more dangerous than conventional methods of producing electricity, and (ii) the U.S.S.R. military forces are becoming superior to the military forces of the U.S.A. Hereafter the first belief topic is referred to as the "nuclear" belief and the second as the "military" belief. The messages dealt specifically with these beliefs, both argued for "true," and both were abstracted from actual news stories presented in the March 8, 1976, issue of *Time*: "The struggle over nuclear power" and "That alarming Soviet build-up."

To ensure that the "truth" argument came across clearly, each of the news stories was modified slightly; included in the nuclear experimental message

was "... nuclear power is potentially more dangerous than conventional sources of power ... To those in the antinuclear camp, the danger is clear, 'the nuclear production of electrical power poses a severe threat to the lives and health of millions of Americans.'" For the military message similar modifications were made; included in the military experimental message was "Whether the Soviets actually plan to attack the Western world, one thing is clear according to NATO Commander in Chief ..., 'The massive Soviet build-up clearly indicates that the U.S.A. is becoming the weaker of the two military giants.'"

Procedure

The subjects were 134 students solicited from the Communication Department subject pool at Michigan State University. Each subject was given a questionnaire booklet that was made up of three parts. The first part contained the belief and information scales which the subject was to fill out for the pretest. The middle section was one of two messages. The subject was asked to "carefully read and underline the main points of the article." The third section consisted of the same belief and information scales which the subject was asked to fill out again as the posttest scores. For the purpose of double checking reliability, a third questionnaire was given one week later. In this design, those subjects who were randomly assigned the nuclear message acted as a control group to those subjects assigned the military message, and vice versa.

Instruments

The belief index was composed of six items. Three were bipolar scales from unlikely to likely, improbable to probable, and false to true. The other three items used a different format. First, the subject was asked to make a forced choice between two endpoints such as true or false, and then to rate his/her confidence in that rating on a 6-point Likert scale from "just guessing" to "certain." This pair of responses was then combined to provide a scale starting from .5 for "just guessing" and counting either up or down in steps of .1 to either one for certain and true or zero for certain and false. The three items of the compound type used the same endpoints as did the three bipolar scales. All six items proved correlationally equivalent when subjected to confirmatory factor analysis. All six items were scored from zero for false to one for true.

The information hypothesis assumes that resistance to persuasion stems from counterarguments that the receiver produces internally. Accumulated information is important because it produces the raw material for counterarguments. For this purpose it does not matter whether or not the information

is correct. Therefore, we did not use an achievement test to assess information. Instead, we asked for subjective confidence ratings. The four confidence measures of information were global ratings on 7-point bipolar scales: "know a little–know a lot," "not aware–aware," "not informed–informed," and "not knowledgeable–knowledgeable." The count information items asked the number of times the belief topic had been heard on each of the four media categories: television and radio, newspapers and magazines, books, and personal contacts. In a pilot study these counts did not relate linearly to the subjective information judgments. The maximal linear correlation was found for the logarithmic transformation. In the main study each numerical count was transformed by the formula $x' = \ln(x + 1)$, where ln is the natural log function.

RESULTS

Scale Construction

Because all measurement was done with multiple indicators, reliability could be assessed by Cronbach's (1951) alpha coefficient. The reliability of initial belief was .97 for the nuclear belief and .96 for the military belief. The reliability of the confidence information measure was .85 for the nuclear belief and .80 for the military belief. The reliability of the count measure of information was .97 for the nuclear belief and .96 for the military belief. A confirmatory factor analysis showed that all constructs were measured by unidimensional indicators.

Message Effect

The means and standard deviations for the pretest, posttest, and belief change are shown in Table 12.1. For those who read the nuclear message, there is a mean change of .126 units on a zero–one scale; for those who did not read this

TABLE 12.1

PRETEST, POSTTEST, CHANGE MEANS, AND STANDARD DEVIATIONS FOR THE VARIOUS SUBGROUPS[a]

Message	*Condition*	*Sample size*	*Pretest*	*Posttest*	*Belief change*
Nuclear	Message	66	.663(.217)	.789(.264)	.126(.187)
	Control	68	.646(.270)	.642(.267)	−.004(.153)
Military	Message	68	.611(.262)	.657(.264)	.046(.163)
	Control	66	.564(.237)	.540(.264)	−.024(.145)

[a] Standard deviations are presented in parentheses.

message, there is a mean change of .004 units. The point biserial correlation for this message effect is .36, which is significant ($F = 19.62, df = 1, 132; p < .001$). For those who read the military message there is a mean change of .046 units; for those who did not read this message there is a mean change of −.024 units. The point biserial correlation for this message effect is .21, which is significant ($F = 6.42; df = 1, 132; p < .01$), though only two-thirds as large as the effect for the nuclear message.

The Pooled Information Measure

The count and confidence information measures are not independent. Corrected for attenuation, the count and confidence measures correlate .81 for the nuclear belief and .73 for the military belief. Thus the two measures were pooled for the first analysis.

Table 12.2 presents belief change as a function of initial belief and accumulated information, using both the confidence and count information measures. The initial belief regions were .00–.35, .35–.65, and .65–1.00. Weighted averages were computed by weighing cells by their sample size whereas unweighted means each cell was given equal weight.

Figure 12.4 presents the change for the nuclear belief in graphic form. The information curves are all discrepancy functions which differ only trivially

TABLE 12.2

BELIEF CHANGE MEANS USING POOLED MEASURES[a]

Initial belief level	*Accumulated information*			*Weighted average*	*Unweighted average*
	Low	*Medium*	*High*		
The Nuclear Belief					
False	.539(2)	.263(2)	.117(1)	.344(5)	.306
Uncertain	.271(18)	.117(5)	.027(1)	.229(24)	.138
True	.070(11)	.010(21)	.012(5)	.029(37)	.034
Weighted ave.	.217(31)	.047(28)	.036(7)	.126(66)	
Unweighted ave.	.293	.130	.055		
The Military Belief					
False	.250(3)	.127(4)	.003(6)	.095(13)	.127
Uncertain	.108(17)	−.060(5)	—	.069(22)	.024
True	.069(6)	.000(22)	−.002(5)	.013(33)	.022
Weighted ave.	.115(26)	.007(31)	.001(11)	.046(68)	
Unweighted ave.	.142	.022	.001		

[a] Belief change means and sample sizes for three levels of accumulated information using the pooled measure and three levels of initial belief.

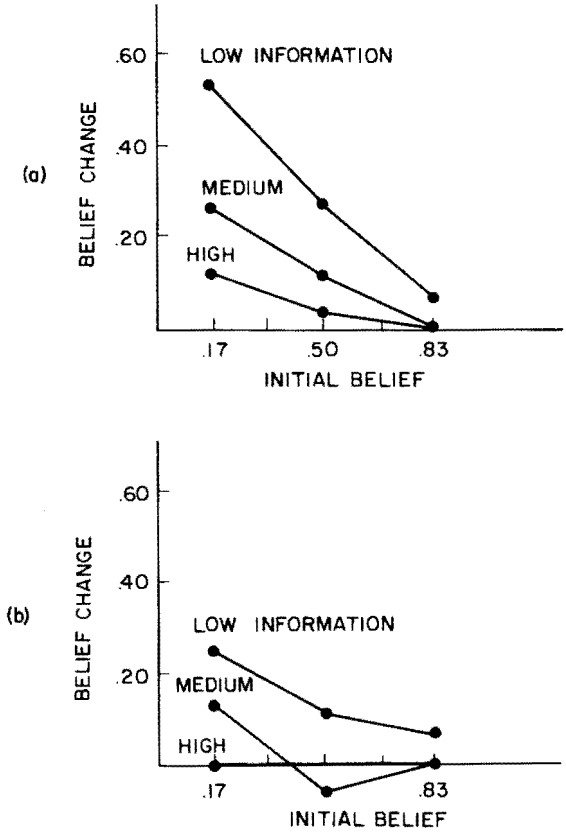

Fig. 12.4. Belief change as a function of accumulated information using the confidence information measure for (a) nuclear belief, (b) military belief.

from straight lines. In each case the departure is concave upward, the opposite to that predicted by the polarity model. Fig. 12.4b presents belief change for the military belief. Although the impact of sampling error is greater against this background of smaller overall change, the impact of information is still large, and the curves are clearly discrepancy functions. Only two curves have a middle point and in both cases the curve is concave upward, the opposite of the prediction for polarity effects.

Both of the experiments show a strong belief by information interaction. Thus main effects are not expected to be meaningful. Problems with main effects in the face of interaction are especially noticeable in the weighted average main effects for the nuclear message. Although all three information subgroups show concave upward curves, the weighted means are concave

downward. The unweighted means across information are concave upward as expected.

According to the polarity model, there should be no differences between information subgroups, yet these differences are massive. According to the hybrid model, each information group should have a discrepancy curve that is concave downward. All five are concave upward. In fact, numerical estimates of β would be negative in all five cases. Thus the simple polarity model is disconfirmed and the hybrid model that assumes polarity effects superimposed on information effects is disconfirmed as well. There are no polarity effects in the regression analyses using the pooled measure of accumulated information.

The regression of belief change onto initial belief and accumulated information measured by the pooled measure of information shows virtually perfect fit to the information processing model, with resistance to persuasion increasing with increased accumulated information.

The Count Measure of Information

Table 12.3 presents belief change as a function of initial belief and accumulated information using only the count information measure. Shown are both belief change for the nuclear belief and belief change for the military belief.

TABLE 12.3

BELIEF CHANGE MEANS USING COUNT MEASURES[a]

Initial belief level	*Accumulated information*			*Weighted average*	*Unweighted average*
	Low	*Medium*	*High*		
The Nuclear Belief					
False	.772(2)	.128(1)	.025(2)	.344(5)	.308
Uncertain	.282(17)	.115(2)	.092(5)	.229(24)	.163
True	.034(12)	.025(8)	.028(17)	.029(37)	.029
Weighted avg.	.218(31)	.051(11)	.041(24)	.126(66)	
Unweighted avg.	.363	.089	.048		
The Military Belief					
False	.378(3)	.037(3)	−.001(7)	.095(13)	.138
Uncertain	.094(10)	.075(6)	.021(6)	.069(22)	.063
True	.017(2)	.020(12)	.008(19)	.013(33)	.015
Weighted avg.	.140(15)	.038(21)	.009(32)	.046(68)	
Unweighted avg.	.163	.044	.009		

[a] Belief change means and sample sizes (in parenthesis) for three levels of accumulated information using the count measure and three levels of initial belief.

Figure 12.5a presents belief change for the nuclear belief. All curves are discrepancy curves. The curves differ greatly for different information subgroups. The curve for low information is concave upward, but the other two curves are concave downward. This pattern is contrary to the hybrid model, but it does not completely disconfirm the hypothesis of polarity effects.

Figure 12.5b presents belief change for the military belief. The results are similar to those for the nuclear belief, though the amount of belief change is much smaller throughout. The low information curve is concave upward and the other two curves are concave downward. Thus the medium and high information curves show evidence of polarity effects, though the pattern does not fit the hybrid model.

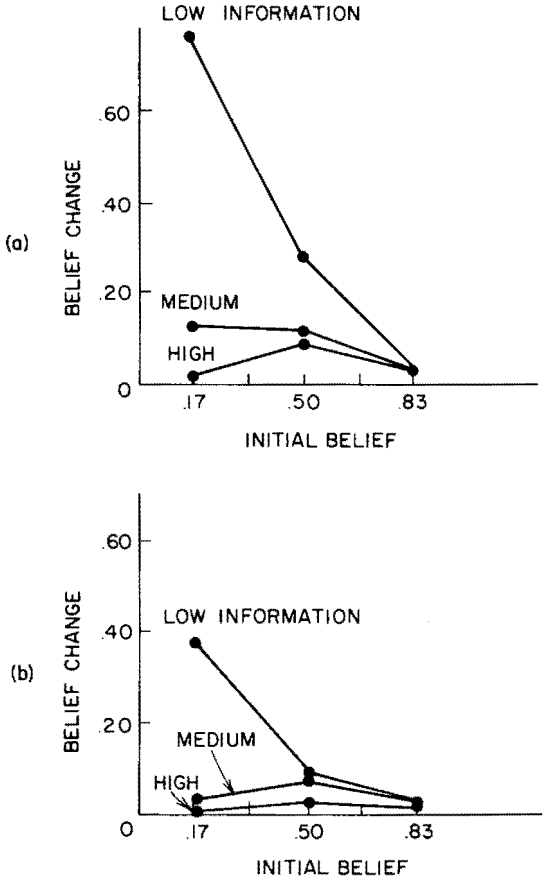

Fig. 12.5. Belief change as a function of accumulated information using the count measure of information for (a) nuclear belief, (b) military belief.

The sample sizes within cells are very small. This opens the possibility that the small polarity effects within certain information subgroups may be due to sampling error. However, the effects are replicated across beliefs. For both beliefs it is the low information group that is concave upward and the medium and high information groups that are concave downward.

OBSERVATIONS

Theoretically, one would expect the count measure to be indirectly related to belief change, because resistance to change is caused by counterarguments. Mere exposure to information does not mean learning. People who are not interested in an issue can tune out or pass over "boring" messages. Thus a high count of exposures to information is a necessary condition for enough learning to construct counterarguments, but it is attentive exposure that counts in the final analysis. On the basis of this theoretical analysis, we are inclined to disregard the weak and inconsistent polarity effects of the count measure analysis.

The empirical test of the models was not as strong as one would desire. For a nonlinear model, certain cells are more important than others. In our study, the crucial cells are those for receivers whose initial belief was false. Because of the direction of our messages, these cells are minority cells. Thus trying to break the data down simultaneously for the information measures reduces sample sizes to atoms. The study could be redone on an issue about which people tend to hold polar views with little basis for them or in a context where a large sample of people with the right views can be drawn from a much larger initial population.

Other Theories

Because source attitude was manipulated to be positive (i.e., *Time* magazine), this study cannot distinguish between the discrepancy curves of information processing theory and those of social judgment theory or dissonance theory. Furthermore, these other theories are both cognitive in nature and compatible with the information effects found here. Thus social judgment theory and dissonance theory fit the present data as well as information processing theory.

Behavioristic reinforcement theory specifically denies the importance of thought as an epiphenomenon. Thus behavioristic reinforcement theory predicts that counterarguments are irrelevant. We see no other explanation for the information effects in this study within reinforcement theory.

Given a positive source, balance theory predicts change in the direction of the message, as was found here. But we see no basis in balance theory for the information effect. That is, we see no way to derive the prediction of

increased resistance to persuasion because of high amounts of accumulated information.

Congruity theory is difficult to extend to this situation. Which source–object discrepancy is to be reduced? Also if congruity theory is to stay as close as possible to conditioning theory, then it too would predict no information effect.

CONCLUSION

This study fits the predictions of information theory and its "cousins," social judgment and dissonance theory. Belief change is predominantly determined by the discrepancy between message and initial belief. However, beliefs based on a large amount of information are more resistant to change, presumably because the receiver is more likely to attend to internal counterarguments.

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