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ATTITUDINAL AND BEHAVIORAL RESPONSES TO DROUGHT-INDUCED WATER RATIONING

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ABSTRACT

Water-usage data from ninety-eight households in Ames, Iowa were obtained for the years preceding, during, and succeeding a year of short water supplies. While huge reductions were made in water consumption during the drought year, an attitude survey indicates that the reductions made were a response to an emergency situation and a municipal water-rationing policy rather than to long-term attitudes toward conservation. The findings reported here closely parallel those reported in the energy literature.

PURPOSE

The purpose of this paper is to analyze some survey data from Ames, Iowa, on the responses to the drought of 1977. The main focus of the analysis is the potential for the use of attitudinal change as means to conserve water. The framework for the analysis and interpretation of the data is the collective-stress framework within which the potential for attitude change is assessed. The analysis does not deal with attitude change variables, rather the data and the analysis are used to support inferences about the *potential* for attitude change.

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BACKGROUND OF THE STUDY

The water situation

A drought in Central Iowa during 1977 reduced the water supply in Ames to such a low level that city officials adopted a water allocation system in July, 1977 for city water users (Flannery, 1978). Each residence was allocated an amount based on the average usage at that residence during a previous period. Residents who used more than the allocation were charged a premium of 7.5 cents per cubic foot of water consumed in excess of the allocation. In addition, car washing, lawn watering, and filling of private swimming pools were banned and fines levied for violators.

Collective stress

The drought in Iowa during 1977, which resulted in a severe shortage of water in Ames, can be classified as a "collective stress situation" (Quarantelli and Dynes, 1977; Barton, 1970). This concept serves to denote collectively stressful situations previously referred to by terms ranging from "crisis" to "disaster." The phenomena referred to differ from traditional social problems because of their acute nature. Social problems typically involve chronic conditions.

Collective stress situations are characterized by conditions in which a critical portion of the members of a collectivity are unable to fulfill their lifestyle aspirations as a result of altered conditions (Barton, 1970). The unfulfilled aspirations produce the individual or household-level stress, which may, in turn reach the critical level that transforms individual misery into collective stress.

Collective stress situations have been classified into consensus and dissensus types (Quarantelli and Dynes, 1977; Warheit, 1968; Waxman, 1973). A consensus stress-situation is one in which "there is agreement on the meaning of the stress situation, the norms and values that are appropriate, and priorities that should be followed" (Quarantelli and Dynes, 1977). Dissensus situations are conflict-ridden situations in which there are groupings within a collectivity with different priorities, norms, values, or definitions of the situation.

The difference between the two types is a matter of degree. Obviously, there would be groupings of individuals in a consensus situation who do not participate fully in the consensus. Indifference and lack of information are somewhat more likely to be involved in a consensus situation than is outright opposition that could produce the conflict inherent in a dissensus situation.

APPROACHES TO BEHAVIORAL CHANGE

Three distinct approaches or some combination of the three can be utilized to encourage the reduction of water consumption: economic sanctions, application of technological innovations, and changes in the attitudes and motivations of households. Although the last are the focus of this analysis, limited discussion of the first two techniques can aid in the interpretation of the role of attitudes, beliefs, and motivations.

Economic sanctions and consumption

An advantage of encouraging a reduction in the use of water through economic sanctions is that the approach does not require the direct change of attitudes. Rationing through manipulation of prices, access to supplies, and the magnitudes of supplies all can have the effect of reducing consumption without the necessity of directly attempting to change attitudes.

The traditional U.S. pricing system for utilities, including water, has been a set of stepped marginal prices that decline with the quantity consumed. The effect (if there is any) on the level of consumption would be to encourage heavy usage. Some proposals have been made to use flat pricing or rising marginal prices to discourage heavy usage of water.

Something approximating a rising price system was applied in Ames as a means of rationing water. Each household was assigned an allocation based on past usage. When usage exceeded the allocation, a higher price was charged.

Technology and consumption

As is the case with economic measures, technological factors, if required by legislation, do not require direct change in individual attitudes or beliefs. If voluntary, however, attitudinal change would be a prerequisite to the adoption and installation of water-saving devices. For some years, technological innovation has been used to postpone or render attitudinal and behavioral change unnecessary. For example, rather than attempt to change attitudes toward birth control and family size to reduce population growth, technology, in the form of machines and chemicals, to increase food supplies has been used.

In response to droughts, water-saving devices, rather than direct attempts to change human motivations and behavior have been used. Building standards that would require water-saving devices in showers, sinks, washing machines, and the like would require the acquiescence of legislators and the support of a bureaucracy to enforce the standards. That acquiescence and support may be more readily obtained than mass changes in attitudes and behavior.

Attitudes, beliefs, and consumption

One of the most widely used approaches to understanding human behavior patterns and how they change is the sociopsychological study of attitudes. Attitudes usually reflect deeper underlying motivations, and therefore, analysis of their effects can serve to enhance the ability to understand the conditions under which behavioral and motivational change can occur.

Attention to attitudes and the potential for attitude change may permit avoidance of some of the side effects of technological and economic solutions such as pollution and inflation. Therefore, it may be suggested that individuals and households might change their wasteful behavior patterns through changed aspirations and motivations. Such changes could facilitate the solution to a collective stress

situation.

Consensus-based collective stress situations such as the Ames water shortage are often quickly responded to with *tour de force* responses in which large amounts of water are saved. That kind of response is difficult to sustain precisely because individuals and households tend to think of the situation as acute and, therefore, temporary. They expect to be able to return to accustomed patterns after the emergency has passed.

Sustaining the conservation reponses beyond the acute phase requires social supports of various kinds that encourage the development of new attitudes, motivations, and aspirations on a widely discussed basis. The necessary social supports include widely shared feelings that saving water is important, wide recognition that there is a burden to be shared, and recognition that those who share in the burden receive rewards of a social nature.

Respect, prestige, and the like are the positive sanctions that tend to encourage the exhibition of particular valued behavior patterns. It is not enough that individuals want to conserve; they need others to support them in their efforts. In the process of being rewarded for good behavior, the notion that saving water is valued by others can, eventually, become a part of the average personality, and the social supports for water conservation can become second nature. It is easy to see, of course, that the pricing system can be a part of that support by rewarding the light user with low prices and punishing heavy users with higher prices.

To facilitate such changes in the thoughts and behavior of people may seem to be a hopeless task. That hopelessness seems to be a portion of the explanation for the tendency of policy makers to favor technological and economic solutions. That attitudes can be changed and manipulated for the purpose of behavior change is shown by the success of advertising. Therefore, it seems unnecessary to reject it *a priori* as a potential public policy.

Although attitude change may not be the program of choice, ignoring attitudes can result in conflict where there might have been none. Water shortages, energy shortages, and the like often appear to be consensus-based stress situations. However, the aftermath of the acute phase often is fraught with conflict. It often is surprising to policy makers that, just as a new program has been installed and it seems to be curbing the appetite for wasteful use of some resource, pressure for the destruction of the program builds.

Water conservation by California households during 1977 was so successful that it began to erode the economic base of the municipal water systems. The threatened and actual price rises in response to the reduced demand quickly undermined the individual's motivation to save water and destroyed much of the consensus.

The degree of consensus about collective stress situations should be analyzed with respect to the acute and chronic phases of the stress situation if the potential for conflict in the transition is to be avoided and the gains made are to be maintained.

THE SAMPLE

The data for this report are based on interviews with 98 households in Ames, Iowa, taken during the winter and spring of 1977-78. In addition, data were obtained from the city water meter records for each of the households interviewed. A number of restrictions on the sample were necessary because of (1) limitations of time and budget and (2) the nature of water metering data.

The effect of the first restriction is obvious. The second factor forced the research to focus on homeowning households because most renters do not have separate water meters, and even if they do, their water bill often is in the landlord's name. Seldom do apartments have separate water meters, and therefore, it was necessary to limit the sample to single-family dwellings as well as owner-occupant households. Mobile home owner-occupants in the city do not typically have separate meters, so all occupants of mobile home parks were excluded as well.

It would, obviously, be out of order to claim to have done a complete study of water use in Ames without including renters and mobile home occupants, especially in a city with a substantial renter population and several mobile home parks. The type of data gathered and the type of analysis done however, would be impossible with a representative sample of all households in the city.

There is a great deal of variation in types of families in the population that is not mirrored in the occupants of single-family owned dwellings. To avoid problems of underrepresentation of, for example, female-headed households, the sample was limited to families in which both the husband and wife were present. Important segments of the population were omitted, but limitations imposed on the study made these compromises necessary and even desirable.

Ames is a city dominated by Iowa State University, and it has a population with a very high level of education and other characteristics common in university-oriented cities. Because of the nature of the limitations placed on the sample and the high level of education, the study may be somewhat conservative in its interpretations.

ATTITUDES, BELIEFS, AND BEHAVIOR

Water use and water-saving behavior

The key variables to be explained in this analysis are the amount of water used and the amount of reduction in water use. The former is given in the number of gallons or the number of cubic feet used in some period of time, and the latter is based on the difference between the amount used in an earlier period and that used in a later period. Water usage was measured by the average number of gallons used during each of the 17 months for which data are available for the survey sample.

The reduction of water consumption

Long-range reduction is based on the difference between the average monthly usage during the first 5 months of 1977 and the first 5 months of 1978. Immediate Reduction is based on the difference between the average monthly usage during the first 5 months of 1977 and the average monthly usage during July, August, and September of that year.

The index of immediate reduction was meant to reflect the reduction of water usage that could be a response to the drought, the rationing that was applied in Ames, and the media coverage of the situation. Thus, immediate reduction was the measure of the response to the collective stress situation. The index of long-range reduction was meant to reflect the reduction of water usage that might be expected to be sustained after the stress was removed by the rains that came in the fall of 1977.

The average household in the sample (Table 1) had a reduction from a usage of 870 cubic feet per month during January-May 1977 to 609 cubic feet each month during July-September 1977. The amount of the immediate reduction was 261 cubic feet per month. The long-range reduction from 870 to 706 was 164 cubic feet each month. Data available elsewhere indicate that these reductions closely parallel the aggregate water use in the city.

Reported reduction in water use

In addition to actual amounts of water used and actual reductions over time obtained from city records, the respondents were asked how much they thought they reduced their water usage over two different time periods. The first period was from before the rationing to the time of rationing. This period corresponds to the immediate-reduction measure. The second period was from the time of rationing to the date of the interview. The purpose of these measures was to attempt to ascertain whether householders had realistic impressions about the amount of water they saved. The questions are quite demanding in that they require the respondent to estimate two quantities and subtract them mentally. The data obtained are subjective estimates as was intended and are not substitutes for the objective data obtained from the city records.

It may be that an ability to gauge one's water-use behavior is a prerequisite to effectively reducing water use through attitude and motivation change. Positive attitudes toward water conservation can be effective in determining water-use behavior only if a sound understanding of the actions that would reduce water use exists. A sound understanding would include the ability to monitor one's own behavior and its consequences for water use.

The scales of reported change in water-use behavior include a series of questions on specific water uses. The uses asked about were the indoor uses and included bathing, showering, toothbrushing, laundry, and several others. The 20 questions on the various uses were subjected to several kinds of scale analysis, which indicated that the responses to the questions were generally consistent.

Respondents who reported reductions in one of the items tended to report reductions in other items.

Table 1. Changes in Water Use Behavior From City Records and Respondent Reports: Averages for the Total Sample

City Records	Jan-May 1977	Jul-Sep 1977	Jan-May 1978
Cu. Ft. Used	870	609	706
Change (Cu.Ft.):			
Jan-May, 1977 to Jul-Sep, 1977	---	-261	---
Jul-Sep, 1977 to Jan-May, 1978	---	---	+97
Jan-May 1977 to Jan-May 1978	---	---	-164
Reported Change			
Jan-May, 1977 to Jul-Sep, 1977	---	-11	---
Jul-Sep, 1977 to Jan-May, 1978	---	---	+5
Jan-May, 1977 to Jan-May, 1978	---	---	-6

*June was omitted because it is a transitional month

The reported reductions (subjective estimates of how much water was saved, e.g., "a great deal") and actual reductions (based on water meter records) were measured on different scales, and the comparisons obviously are somewhat arbitrary. The distribution of each variable was simply trichotomized into three groups of as nearly equal size as possible.

The data for the total sample (Table 1) indicate that the reported reductions roughly parallel the reductions shown by actual water usage for the city and for the sample. The substantial reduction from the period before the rationing to the rationing period itself and the return to a higher level, but below that of the prerationing time, appears in these data as well as in actual use records for the sample and the aggregate consumption for the city.

Table 2 shows the relationship between actual and reported change in water use. Of the 33 households with substantial reductions, less than half reported they made substantial reductions. Of those who reported moderate reductions, less than half actually made moderate reductions. Just half of those with slight reductions reported they thought they had made slight reductions. Thus, 43 of 98 households correctly reported their reductions while 30

underestimated and 25 overestimated the amount of reduction.

Table 2. Cross Tabulation of Actual Changes in Water Use Between January-May, 1977, And July-September, 1977 With Reported Change

	Reported			
Actual	Substantial Reduction	Moderate Reduction	Slight Reduction	Total
Substantial Reduction	14	10	9	33
Moderate Reduction	9	13	11	33
Slight Reduction	9	7	16	32
Total	32	30	36	98

Belief in the shortage situation

To measure the extent of belief in the crisis, three questions were combined to form an index for the analysis. The three questions referred to (1) the existence of the shortage, (2) the seriousness of the shortage for the city, and (3) the seriousness of the shortage for the household itself.

About 90 percent of the sample believed that there was a water shortage. About 85 percent believed the shortage was serious for the city. About 65 percent thought it was serious for their own family. The combined scale produced scores that could range from 0 to 6. Almost a quarter (23.5 percent) held strong beliefs in the shortage and achieved scores of 4 or 5.

Attitude toward conservation

The attitudes of respondents toward conservation of water were measured by a scale developed from a set of six items in the interview. The respondents were asked to give their responses to those items on a five-point index from 1, strongly disagree, to 5, strongly agree. The items used bear on the question whether people should conserve before or after shortages began, whether people have a right to unlimited water and the like. The scale exhibited a high level of consistency and reliability, with a coefficient of 0.75.

Satisfaction with city actions

Because the rationing of water was a city policy, it seemed important to include questions in the interview about satisfaction with the way officials handled the situations. One prerequisite to a strong conservation response to the water shortage would seem to be acceptance of the rationing and other actions of the city in dealing with

the situation. About 60 percent of the sample were satisfied or very satisfied with the way the city officials handled the situation. That level of satisfaction, combined with a belief in the shortage and positive attitudes toward saving water, could be key elements for understanding reduction of water use both during the rationing period and the maintenance of conservation after the acute phase of the collective stress situation has passed.

Water-use knowledge

The original plan of this research included a knowledge component. It was believed that, if a respondent had a solid knowledge base, had realistic impressions of the amount of water used and saved, had positive attitudes towards conservation, and had confidence in the city administration, the likelihood of conservation behavior would be very high. Unfortunately, the questions used to assess the level of knowledge are not reliable for this sample. A respondent who knew the correct answer on a particular aspect of water knowledge was no more likely to know the correct answer to another item than a person with the wrong answer. The level of knowledge of this sample is low and disorganized. This conclusion casts doubt on the possibility of attitude change having an important effect on behavior until the level of knowledge is improved. The data on knowledge were omitted from further consideration in this report.

Reduction in consumption and conservation attitudes

The amount by which water use was reduced as an apparent immediate response to the drought and the rationing seems to be only marginally related to belief in the shortage (Table 3). About 39 percent of those with strong beliefs in the shortage made substantial immediate reduction in water use. Those with weak beliefs reduced slightly more than the moderate believers did. About 31 percent of those with moderate beliefs in the shortage made substantial immediate reduction. Apparently those with moderate beliefs are slower to react than both weak and strong believers because the long-range percentage with a substantial reduction is higher. These findings are quite weak and lend only minor support to the proposition that believing that a stress situation exists facilitates the behavior that could help to relieve the stress.

Contrary to expectation, those who are satisfied with official action are less likely (30 percent) to have made substantial immediate reduction than are those who are not as satisfied (about 40 percent). This conclusion applies to immediate and long-range reduction. Perhaps those who are satisfied feel that they personally need do nothing because the situation is being dealt with.

The relationship of immediate reduction in water use to attitudes toward water conservation is characterized by a curvilinear pattern, somewhat similar to the belief data. Respondents with neutral or negative attitudes and those with strongly positive attitudes are more likely to have substantial reductions than are those with moderately positive responses. In the long-range column, the percentage with substantial reduction is higher the more positive the attitude.

Table 3. Percent Substantial Reduction By Attitude Variables*

	Immediate Reduction	Long-Range Reduction
Belief in the Shortage		
Weak	33.3	30.6
Moderate	30.8	35.9
Strong	39.1	30.4
Total	33.7	32.7
Gamma	0.06	0.06
Satisfaction With Official Acts		
Not satisfied	39.5	39.5
Satisfied or very satisfied	30.0	28.3
Total	33.7	32.7
Gamma	-0.16	-0.17
Conservation Attitude		
Neutral or negative	38.4	23.1
Moderately positive	21.4	35.8
Strongly positive	38.7	41.9
Total	33.7	32.7
Gamma	-0.04	-0.14

*Gammas based on complete 2x3 or 3x3 contingency tables. The original contingency tables are available on request to the senior author.

The general pattern of these data seems to indicate that beliefs, satisfaction, and conservation attitudes do not have (in an unequivocal way) the relationships to stress-induced conserving behavior that were expected. Individuals who have strongly positive attitudes toward water conservation may already have a tendency to maintain and even increase their water use reduction over the long-range unlike the neutral or negative who have a tendency to slip out of the long-range substantial-reduction category. It is conceivable that some personality factor such as suggestibility precipitates early responses in a stress situations while stubborness delays responses for some and supports maintenance of conservation in the long-range for others.

Immediate reduction and household characteristics

The amount of effect that the attitudes have on water conservation may be affected by the characteristics of the households (Tables 4 and 5). It is shown quite clearly that the amount of water saved is related to household characteristics. The dominant effect of age seems to be to produce lower reductions among the older households, as shown by the negative correlation (gamma=-.19). The greatest likelihood of substantial immediate reduction is among the middle-aged households with over half having substantial reductions. There

clearly is a curvilinear relationship to age.

The number of people in the household shows that a positive correlation between household size and the amount of reduction is the dominant pattern. However, the substantial reduction reaches a plateau at four persons. The effect of education is fairly strong, with greater reduction associated with higher education.

Long-range reduction and household characteristics

The effect of age of the husband on long-range reduction is similar to (but weaker than) its effect on immediate reduction (gamma=-.09), with the greatest reduction occurring among the middle aged and, the least, among the elderly. The effect of the number of persons in the household on long-range reduction is very similar to that for immediate reduction. Substantial reduction is much more prevalent among the larger households than among the smaller ones. The effect of education on this variable likewise is similar to its effect for the short run. Higher levels of education are accompanied by greater amounts of reduction.

Table 4. Percent Substantial Reduction by Socioeconomic Variables

	Immediate Reduction	Long-Range Reduction
Number in Household		
2-3	21.4	16.7
4	42.9	45.7
5 or more	42.9	42.9
Total	33.7	32.7
Gamma	0.29	0.24
Wife's Education		
8-12	27.6	20.7
13-15	25.0	28.6
16 or more	43.9	43.9
Total	33.7	32.7
Gamma	0.24	0.26
Age of the Husband		
26-40	30.3	33.3
41-52	54.5	45.4
53 or more	15.6	18.8
Total	33.7	32.7
Gamma	-0.19	-0.09

Attitudes toward conservation by household characteristics

There are a number of notable effects of household characteristics on the attitude variables (Table 5). Belief in the shortage is

possibly stronger among the middle aged than among the elderly, but the dominant effect is the higher level of belief among the middle aged and over compared with the younger age grouping (gamma=-.31). Belief in the shortage is strongest among the larger than the smaller households (gamma=.11). Belief in the shortage is rather closely related to the wife's educational level (gamma=.32). Nearly 40 percent of those with a college degree had strong beliefs, compared with less than 7 percent of those with no higher education.

Table 5. Rank Correlations Between Attitude Variables and Socioeconomic Characteristics

	Belief	Satisfaction	Attitude	Immediate Reduction	Long-range Reduction
Age	-0.31	0.11	0.10	0.29	0.24
Household Size	0.27	0.16	0.09	0.24	0.26
Wife's Education	0.32	0.17	-0.12	-0.19	-0.09

Satisfaction with city's actions is somewhat greater among the middle aged and above than among the younger respondents (gamma=.11). The larger households, compared with the smaller, have higher levels of satisfaction with city actions (gamma=.16). The high and low ranges of education are characterized by greater satisfaction than is the middle range of education (gamma=.17).

Attitudes in favor of conservation are more positive among the middle aged and above than among the younger respondents. Conservation attitudes have very weak relationships with household size and education.

DISCUSSION

This paper is an analysis of some of the effects of the drought of 1977 in Ames, Iowa. The drought is viewed in the sociological framework of the "collective stress situation." A collective stress situation such as the 1977 drought is an acute situation in which a significant portion of the members of a collectivity (the city of Ames) is unable to fulfill their established life-style aspirations as a result of some change. In this case, the change was the reduced supply of water. The effect on life-style was the inability to continue accustomed patterns of water use.

The magnitude and rapidity of the decline in water usage in the city during the summer of 1977 as the stress situation developed is evidence of the substantial consensus in the city about the existence of a water shortage and the appropriateness of extreme conservation measures. The data on water use in the city based on the sample demonstrate clearly that the Ames water users responded forcefully to

a perceived problem with behavior appropriate to an acute stress situation. In short, they took emergency measures. Ames water users reduced water usage to a very low point during a season in which water usage typically is high and rising.

Questions raised in the research included whether positive attitudes toward conservation could be seen as a means to preventing future water-shortage situations. Presumably, a trend in the direction of more favorable attitudes toward saving water could be fostered to keep usage down. This question has been studied in the last few year in regard to energy conservation.

There are many similarities between the findings in this study and those in the studies of attitudes and energy-conserving behavior (Niemeyer, 1982; Gladhart, Zuiches and Morrison, 1978). The attitudes of residents about the seriousness of energy problems play almost no role in determining their conservation practices. The research indicates programs to change attitudinal predispositions in order to bring about energy-conserving behavior would not be a fruitful approach.

The evidence in the present data suggests that the same is true in regard to water conservation. There is a very low and disorganized level of knowledge about water-use practices. Only a third of the sample appears to be able to accurately monitor the amount of water used. Positive attitudes toward conservation, satisfaction with city programs, and belief in the shortage had weak to moderate effects on water-use reduction during the shortage, and those effects were not always in the expected direction.

With respect to the rationing system, there are some limited data on its effects. The pattern shown in the data is consistent with a declining marginal price system. Apparently, the average user reduced water usage so much that little water was used above the allocations; therefore, little direct effect on the prices paid by the average user was possible.

The indirect effect may have been minor as well. The indirect effect would be the effect on usage that the expectation of a higher price would exert. There is room for interpretation, but it is evident that the reduced usage preceded the application of allocations. A great proportion of the reduced usage was due to the reaction-to-an-emergency syndrome of a consensus-based collective stress situation rather than to the effects of the allocation system.

This sample of highly educated people, many of them skilled scientists, does not have the level of knowledge required to rationally implement their positive attitudes toward water conservation. Optimism in general seems inappropriate until specific water-use knowledge and how to monitor one's own use of water are more widespread.

Nevertheless, huge reductions were made in the consumption of water, and practically all households studied reduced their usage somewhat during the shortage situation. After the rains came, the sample seemed to be using less water than they would if there had been no shortage. Some of the water-saving actions taken during

the drought continued to hold consumption down afterwards. It seems reasonable to speculate that, after the emergency had passed, most emergency measures were dropped except that few people removed toilet inserts, water-saving showerheads, and the like. When emergencies pass, apathy may take over except among the most strongly committed, and conscious water-saving behaviors could be dropped, but the removal of devices would require unusual negative motivation toward water-saving measures and would be very unlikely.

These findings may or may not indicate that the devices that require no attitudinal or sustained behavioral changes promise most for saving water in the long run. At the least an attitude change program probably should be preceded by an educational program to raise the level of knowledge.

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