

THE WAYS PEOPLE THINK ABOUT WATER*

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ABSTRACT

Despite the significance of water in all facets of human life, there is little replicated information about how people think about the resource. In this study, two samples of people were asked how often they “thought about water” in fourteen different contexts varying from the “rights to water” and its environmental and aesthetic significance, to aspects of water as a domestic commodity. The responses to many questions were often skewed. Responses to the questions were found to be largely independent. However, three consistent factors emerged: “conservation,” “aesthetics,” and “utility.” Cluster analysis showed consistent patterns of responses between the two samples. Attitudes toward personal rights to water was an influential variable in cluster analysis. Cluster membership did not relate to household water consumption. Further research, using hierarchical models of thinking and relating cluster membership to water-policy attitudes is suggested.

INTRODUCTION

Water can be the most mundane yet most wonderful of resources. In countries such as Australia, when used for domestic purposes, water is plentiful, clean and cheap, despite recent trends to increased costs and consistent conservation

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campaigns. Functionally, it is also our most common solvent. At the same time, it is an essential component of exotic scenery in national parks, an irreplaceable habitat for the ecosystem, a source of recreation and, to many, a basis for spirituality.

The multi-purpose nature of the functions of water from the human perspective is obvious. How people conceive and interpret such a diversely used resource is another question. Individual differences in this conception may govern human attitudes toward a wide variety of issues, from conservation through to allocation of the resource.

In the context of water planning, Harris has provided the only multidimensional analysis of conceptions of water in an attempt to find some underlying dimensions which could assist planners within a multi-objective decision-making framework [1]. With a sample of three hundred respondents from disparate sub-groups, he used multidimensional scaling techniques to find five principal vectors relating to: quality of drinking water, allocation and conservation, natural beauties of water, public involvement, and public access to water bodies. These vectors were apparently consistent between sub-groups (e.g., social scientists and water engineers).

There has been surprisingly little further research on whether there are consistent dimensions in the ways in which people integrate their thoughts on this resource. The studies available have been conducted from the perspective of a particular activity, use, or amenity associated with water.

For example, Syme and Williams examined the structure of perceptions in the context of aesthetics of drinking water [2]. Smith and colleagues have examined color and clarity in terms of recreational use of water for bathing [3, 4]. Other authors have discussed the meaning of water in cultural or spiritual terms [5].

While such studies are of great value to planners for specific purposes, water can be simultaneously viewed in many ways by the general public within any environmental or decision-making context. For example, many regional studies of water resources management and allocation require multiple uses (e.g., potable use, industrial use, recreational use, etc.) to be considered simultaneously [6]. By establishing the community's cognitive representation of the resources as a whole, significant progress may be achieved in devising social criteria for balancing utility, environmental management, and equity-based water policies.

Further, if there are reliable individual differences in initial conceptions of the resource, there is an argument that these should be represented in any comprehensive public involvement program [7]. To date, the rare evaluations of representivity of public involvement programs have mainly been in demographic terms, or in on-off attitudinal [8] measurements. However, there is a need to establish whether there are any consistent patterns of thinking about water to explore whether it is feasible to go beyond demographic variables when we are considering the adequacy of representation.

For these reasons, this research examines how the general community structures their thoughts about water in a variety of guises and uses, and attempts to establish whether there are any identifiable sub-groups of ways of thinking about it. This exercise is repeated within two separate studies, conducted two years apart to establish the consistency of findings.

METHOD

Procedure

The ways people think about water were assessed in fourteen items in two major studies. The first study was conducted in three cities in Australia, primarily to establish people's needs for communication and public [8]. In total 1080 people were personally interviewed, one-third each in Perth, Canberra, and Sydney. The sample in all cities was chosen on a stratified random basis and was therefore reasonably representative of the city. Household water consumption figures were collected in this study (with respondent permission) from the water authorities. The second study was an experimental study of householder satisfaction with water pressure conducted with 655 respondents in Perth two years later [9]. This sample, also personally interviewed, was stratified by higher or lower socio-economic status in each of three water pressure regions; high, medium, and low pressure.

Instrument

Fourteen aspects of water were chosen for analysis. These were developed from two sources. A number of themes were adapted from Harris' dimensions [1], while others were commonly occurring issues in water management as relayed to us by water managers in the three cities of Study 1. These issues have previously been discussed in the water literature [10]. These are shown in Table 1 and are largely self-explanatory. The importance statement (Item 9) was used to establish whether water was a reasonably central concern to the respondent [11], as has often been assumed by water managers and planners.

The respondents were asked to rate each of the statements on a 5-point scale from (1) "I *always* think of water this way" to (5) "I *never* think of water this way" (always, often, sometimes, rarely, never). This scale was chosen after considerable pre-testing in earlier studies where it was found that traditional "agree/disagree" scales were not conducive to people thinking about the relative emphasis that they put on the various functions of water. They resulted in small variations in responses. With the "think scale," an emphasis on the cognitive components of attitudes [12] occurs, although affect and aesthetics were included in some statements.

Table 1. Statements and Percentage Frequency of Responses to Each of the Fourteen Items on the "Think Scale" from Study 1

Statement ^a	Percent Response				
	Always	Sometimes	Never		
	1	2	3	4	5
1. ^u I think of the supply of water to my household as a service similar to that of the supply of electricity.	54	21	12	6	8
2. ^s I consider water to be a necessity of life and as such I should not be limited in my use of it.	24	20	17	19	20
3. ^c I consider water to be a scarce resource of Australia which must be carefully conserved.	44	23	18	11	5
4.* I consider that tap water plays an important part in my diet for healthy well-being.	47	21	13	10	8
5.* Water has great religious importance to man.	8	6	10	19	57
6. ^a Since water provides a habitat for wildlife and vegetation, efforts should be made to ensure its preservation.	50	30	14	4	1
7. ^u I think of the supply of water to my household as a service similar to that of the supply of public transport or health services.	25	20	16	21	18
8. ^a I consider that bodies of water in the natural environment provide areas of great scenic beauty.	54	32	13	2	1
9.* Water is very unimportant compared with other concerns in my life.	5	9	15	25	47
10. ^a I think the sounds of natural running waters provide a great source of enjoyment.	41	30	18	6	4
11. ^s I consider that tap water contains too many chemicals and minerals to be good for my health.	18	16	25	25	17
12. ^u I think of water as a consumer item similar to bread, milk, fruit, and vegetables which increase in price over the years.	17	21	23	21	18
13. ^c Since water is replaceable, there is no need to conserve it.	3	4	8	25	60
14. ^a Viewing natural bodies of water is very calming.	47	34	14	3	2

^aa = Aesthetics, c = conservation, u = utility, s = singleton, * = discarded.

There were some minor changes in wording from the first to the second survey. "Water has great religious importance to man" became "Water has great spiritual importance to mankind," as interviewers felt people may have been uncomfortable with the first statement in the first study.

The statement, "I consider water to be a necessity of life and as such I should not be limited in my use of it," was changed to "I should not be limited in my use of water because it is a necessity of life." This was done because interviewers reported that respondents often complained that the first statement contained "two ideas," which made it difficult to rate.

Analysis

The analysis attempted to find whether there were any identifiable dimensions in responses to the fourteen statements and, if so, whether there were any identifiable systematic differences in the ways they were answered.

The following analyses were conducted for the sample in the first study and were replicated for the second.

1. An item (distribution) analysis.
2. Pearson Product moment (PM) correlations among the fourteen items.
3. An exploratory factor analysis (EFA) [principal axes followed by varimax rotation] of the scale based on PM correlations.
4. Polychoric correlations (PC) between items [13].
5. An EFA of the scale based on PC correlations.
6. Agglomerative clustering of the fourteen scale items based on the absolute values of the PC correlations using the average linkage between groups method [14].
7. A nearest centroid (Euclidean distance) cluster analysis [14] of the cases based upon the sub-scales derived in analyses 3 to 6.

The analyses for the first sample are presented here in detail, and are only commented on as necessary for the second sample.

RESULTS

Item Responses

The percentage frequency of responses to each of the fourteen items on the "think scale" is shown in Table 1. Similar patterns of responses occurred in Study 2.

It is noticeable that the responses on most items were skewed. Those that showed a spread of responses were personal use items, portraying the nature of water as a right, a service, a consumer item, and a perceived health risk as drinking water. The non-personal use items such as those pertaining to

conservation, beauty, and religiosity tended to be highly skewed. The three personal items which were skewed related to the importance of water overall and as a component of diet, and the comparison of the supply of water with that of electricity.

The pattern of responses for the items suggests, *prima facie*, that they would cause problems in analyses based on the assumptions of univariate and multivariate normality.

Product moment correlations among the items were generally small (mean = 0.0841, variance = 0.0191) and not significant. Similar findings were evident for the second sample. It was evident that the responses to items were generally independent. The specific aspects of the differing water roles and issues seemed to be highly discriminated by both samples.

Item Structure

An exploratory factor analysis, perhaps not surprisingly, failed to reveal any interpretable structure.

The absence of significant correlations among items of a putative scale may reflect their independence, or may result from properties of the data that render product moment correlations inappropriate. In this case the latter seems likely as *prima facie* the items ought to be correlated but their distributions are conspicuously skewed. Where ordinal measures are used and their distribution does not follow a quantized Gaussian distribution, product moment correlations will give biased estimates of the extent of linear relations among the latent variables represented by the measures (scale items) if these latent variables are normal. In such cases the use of polychoric correlations has been recommended [14]. A detailed mathematical justification for the use of polychoric correlation and a series of Monte Carlo simulations to demonstrate its use has been provided.

As a consequence, the data were reanalyzed using polychoric correlations (PCs). These are estimated correlations based on a rescaling of the responses where it is assumed that there is an underlying bivariate normal distribution. These correlations had larger absolute values. Exploratory factor analyses did produce three interpretable factors. These factors could be labeled: AESTHETICS (Items 8, 10 and 14 loaded highly on this for both samples); CONSERVATION (Item 3 and Item 13 loaded highly for both samples); and UTILITY (Items 7 and 12 loaded highly on both factors).

Nevertheless, the three factors were only partially replicated. Item 6 loaded on AESTHETICS for sample 1, but not for sample 2. Item 11 loaded on UTILITY for sample 1, but not sample 2, and Item 2 shifted from CONSERVATION to UTILITY. Several items (e.g., Items 4, 5 and 9) did not load on any common factor.

For this reason, the structure of the items was further explored through item cluster analysis. Cluster solutions were based on absolute PC correlations as

similarity indices. The icicle plots of the solutions for samples 1 and 2 were similar, and reinforced the hypothesis that the data could be represented by three common factors.

Although Item 2 initially clustered with Items 1, 7 and 12, it separated at the second partition of the data. Item 11 was an isolate, as was Item 2. The remaining items (4, 5 and 9) were not included in any further analyses. Items 4 and 9 appeared to be “larger” and more generalized statements than the others, and Item 5 had been worded slightly differently between the two samples (“religious” changed to “spiritual”).

The icicle plots for the two samples were similar. The final selection of items for the sub-scales was based on the pattern of item loadings for both samples from the factor analyses of the PC correlations, and the cluster analysis based on absolute PC correlations. The sub-scales represent a “common” structure for the two samples. The final selection of items to represent the three sub-scales for further analyses were:

AESTHETICS	6	8	10	14
CONSERVATION	3	13		
UTILITY	1	7	12	

Individual Differences

Individual scores were generated for each of the three factors (sub-scales). These scores were the means of the items associated with each sub-scale. These three scale scores, together with Item 11 (chemicals in water-ADDITIVES), were used to provide individual profiles for cluster analysis. A test five-group solution with Sample 1 data produced one unacceptably small group. Two- and three-group solutions contained overly aggregated groups. For this reason, a series of four-group solutions were generated for both Sample 1 and Sample 2.

1. Sample 1 — all cases
2. Sample 1 — Perth cases
3. Sample 1 — Sydney and Canberra cases combined
4. Sample 2 — all cases (i.e., Perth cases)

The analyses produced qualitatively similar results, that is both studies and both Perth samples and those from other cities showed the same pattern of groups. These are shown for Sample 1, all cases in Figure 1.

This analysis was then repeated including Item 2, “I consider water to be a necessity of life and as such I should not be limited in my use of it” (WATER RIGHTS). The effect of the response pattern for this item revealed in the icicle plots had suggested it may have played a role in moderating people’s thoughts about water.

In the first analysis, means for each of the four clusters were calculated for WATER RIGHTS (see Figure 1). In the second analysis, the data were clustered

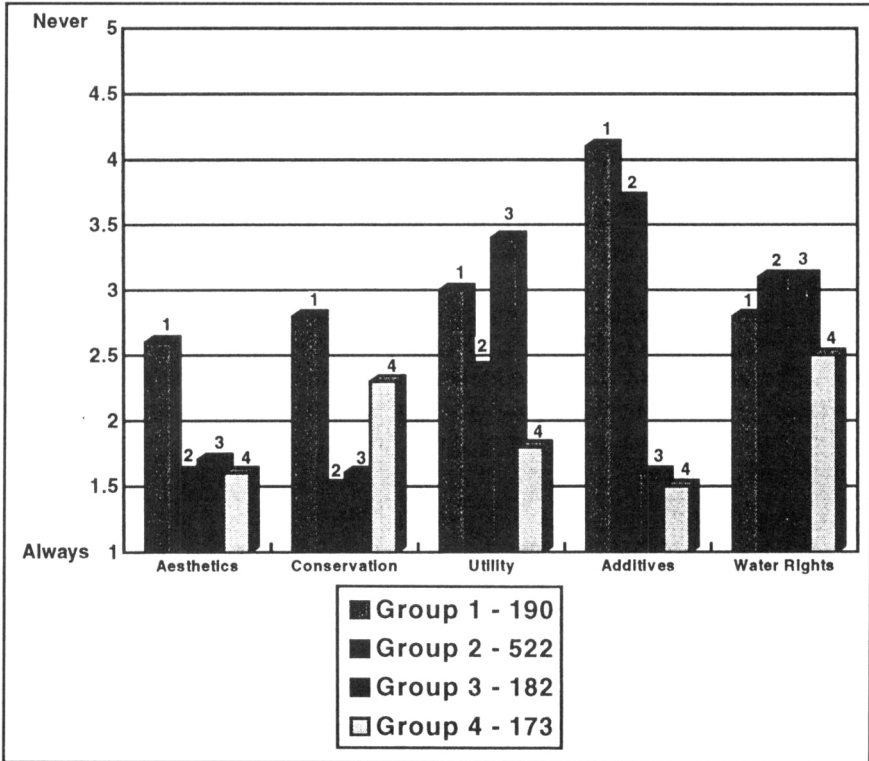


Figure 1. Four-variable clusters and means of each cluster on "water rights." Sample 1 — all cases.

on the four previous variables *and* WATER RIGHTS. It can be seen in Figure 2 that the profiles of the groups produced in the second five variable analysis were similar to those of the four variable solution. However, the differences between each of the groups on each of the matching four variables was less pronounced.

A comparison of the analysis with and without WATER RIGHTS suggests that the difference between cluster means for the AESTHETICS and CONSERVATION factor scores are not as evident when WATER RIGHTS are included in the cluster analysis.

The degree of overlap between the four-variable and five-variable four-group solutions is shown in Table 2.

In Table 2 the four-group solution has been used as the base and the five-variable solution as the match. In a perfect match, only the diagonal cells would have entries. In this case, the base solution has all its best matches in the diagonal, while the five-variable solution is mismatched for column three.

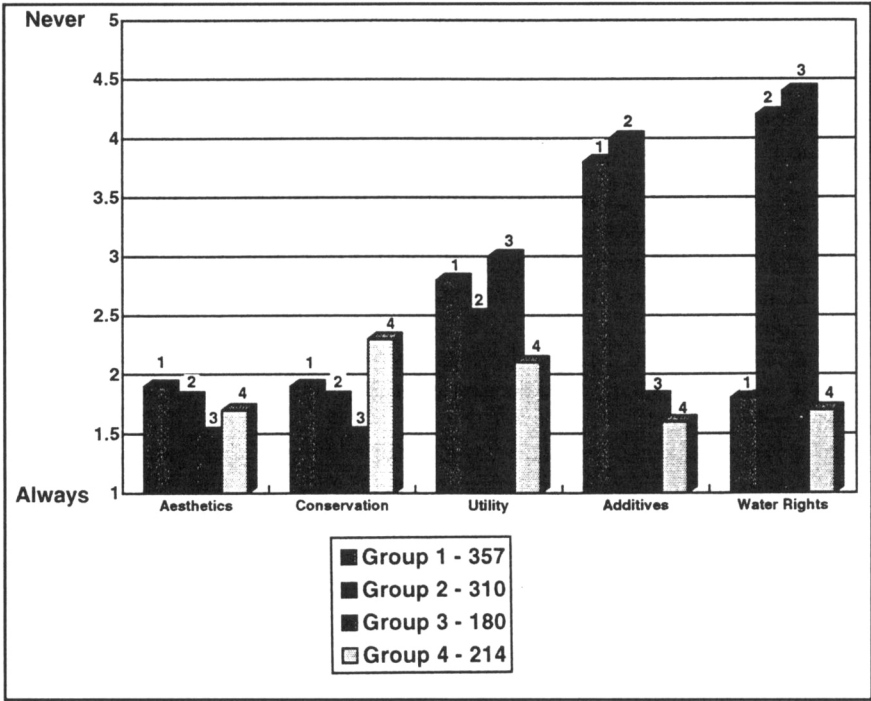


Figure 2. Five-variable clusters. Sample 1 — all cases.

Table 2. Match of Five-Variable and Four-Variable Four-Group Clusters

5-V	1	2	3	4	% Base
4-V					
1	134	5		31	79
2	22	230	<u>223</u>	45	44
3	9	75	105	1	55
4	44		29	103	57

The four item clustering of respondents also showed a reliable structure. This structure seemed to be mediated, to some degree, by responses to WATER RIGHTS.

The four clusters (see Figure 2) seemed to reflect the following thought structures:

1. *Self-Interested*: people with a general lack of strong thought about water in any context other than “their rights.”
2. *Earthy*: individuals who generally thought about water in its aesthetics, conservation, and utility contexts, but not in terms of additives or water rights.
3. *Environmentalists*: respondents who were primarily concerned about water in terms of aesthetics and conservation rather than the utility or water rights contexts.
4. *Service Oriented*: people who generally thought about water in all its contexts, but more so in terms of rights, additives, and utility and least likely in the conservation context.

When the WATER RIGHTS statement was included, the difference between the cluster means for AESTHETICS, CONSERVATION, and UTILITY was not as evident. It would seem, then, the water rights statement has a significant discriminating influence on the clustering. The means of Clusters 2 and 3 were markedly higher than for the remaining clusters.

Ways of Thinking and Household Water Consumption

To establish whether cluster membership could be related to any water behavioral variable a regression analysis, including dummy variables for cities, was conducted of water consumption (sample 1) on the variables used in the cluster analyses: AESTHETICS, CONSERVATION, UTILITY, ADDITIVES, and WATER RIGHTS. The results suggested that the ways people think about water does not predict their water consumption. However, it should be noted that the consumption data were household figures, whereas the cognitive data were from individuals.

In addition, the first study, allowed us to assess whether cluster membership related to reported willingness to be involved in water resources planning and actual attendance at community workshops [15]. There proved to be no significant relationship.

DISCUSSION

The results showed that there were a number of single items where there was substantial similarity or dissimilarity of thought. These findings proved to be reliable across the two samples. Secondly, there seemed to be only a modest

correlation between many items, suggesting that people think about the roles, functions, and symbols of water in daily lives somewhat independently.

Those items in which there appeared to be greatest ambivalence or variability in both samples' responses related to human use in one form or another [16]. There was a significant spread in thoughts about water as a utility and about household water quality. At a general level, most people thought it an important feature of everyday life, but there was more variation in the item which investigated the right to consume water because it is a necessity of life. This "water rights" issue later proved to be an important discriminating variable for clustering results.

The significance of water in its environmental roles was clearly appreciated and quite salient to most respondents in both samples. The concept of the significance of water in the natural environment and its consequent benefit for humans appeared to be well appreciated. Perhaps the only surprising finding was the reluctance of the respondents to see the resource in a spiritual or religious light. This may reflect lay thinking, despite the significance of water to the symbols within our psyche [17]. More pragmatically, it may also be an artifact of the methodology adopted in this study in that people were asked about their "thinking" in an area which may be symbolic rather than cognitive. More qualitative methods may be successful in gaining a better understanding of this variable in the future.

The multivariate analysis did, however, reveal reasonably repeatable factorial and cluster structures of variables. The first two factors "aesthetics" and "conservation" seem similar to those derived from professionals [1]. The "utility" factor indicates that the health, nutrition, and resource natures of water have some consistent positive relationship in thought. Interestingly though, the item on additives, which had a broad spread in responses, was largely independent. Perhaps this reflects an overall concern with pollution issues associated with drinking water, rather than the quality of product as a consumer item.

The cluster analysis showed that there was a tendency for repeatable clusters to be identified. Although the thought structures of each cluster were not predictive of household water consumption as had been the case in previous attitudinal studies in Perth [e.g., 18], this may not be surprising in that this study examined attitudes more specifically related to indoor usage [e.g., 19]. Cluster membership also did not predict interest in becoming involved with water resources planning nor acceptance of an invitation to do so. Thus it seems to be practically possible to ensure that all types of cognitive approaches are sampled to ensure breadth of input to public involvement programs.

CONCLUSION

The thought structures reflected in the four clusters may underlie general approaches to major policy issues, such as pricing, restrictions, or allocation

issues. If this is the case, with an increasingly corporatized water industry in many countries, this could be a valuable approach to ensuring that all consumer segments are considered in decision making and for judging the adequacy of public involvement in representational terms. It may also provide a valuable mechanism for targeting communication strategies on particular policy issues.

The tactic taken here has been a fairly standard data reduction approach for psychological research. However, the apparent mediating effect of the "water rights" item on the clustering, and its apparent centrality as an issue in water management, seems to indicate a more systematic hierarchical investigation may provide further improvement in our understanding of people's thoughts about this most diverse of resources.

While there were replicable clusters in these Australian studies, it would be interesting to assess whether the clustering shown here would occur in other cultures. At minimum, however, these studies demonstrate the efficacy of the quickly administered think items which could well be used on a routine basis by agencies conducting ongoing public involvement programs.

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