Clemens Greiner, Waltraud Kokot (Eds.)

Networks, Resources and Economic Action

Ethnographic Case Studies in Honor of Hartmut Lang

Dietrich Reimer Verlag

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Green Cognition and Behavior: A Cultural Domain Analysis

This chapter provides a detailed example of cultural domain analysis—the study of the content and structure of shared beliefs about areas of culture (Borgatti 1992; Boster 1987)—in service to answering three questions of practical interest:

1. Is there, in the United States, a cultural domain of green behaviors?
2. If there is, how widely is it shared?
3. How is the domain structured? That is, what are the components of the domain and how do they relate to each other?

We began our research in 1996, the year that Herndl and Brown published their edited book, "Green Culture: Environmental Rhetoric in Contemporary America," and a year after Kempton, Boster, and Hartley published "Environmental Values in American Culture." We were asked by engineers at the Ford Motor Company if we could help define the putative domain of green behavior, or "things people think they can do to help the environment."

Note the word "think" in the previous sentence. Cultural domains are part of emic culture, so the study of those domains is necessarily about what people think they do — or what they think others do or might do — not what they do.

Defining a Green Domain

Defining a cognitive domain is often done by asking people to free-list items that belong together. "List all the illnesses you can think of," for example, is a commonly given instruction in the study of health-care behavior.

Another way to get a list of the contents of a domain is to begin with open-ended interviews and to extract the contents of the domain from the free-flowing responses of informants to broad questions and probes. The disadvantage of open-ended interviews is that they produce reams of transcriptions to pore over; the advantage is also clear: Informants can open up and interviewers can explore and probe to create the most complete list possible.

We began with several completely unstructured interviews to learn about the topics to cover in more structured interviews. Once we had a protocol in place, we did 12 open-ended interviews — 10 in Gainesville, Florida, and 2 in Los Angeles, California. In Gainesville, four of the informants were African American. Appendix 1 shows the protocol we used in our open-ended (semistructured) interviews.

These interviews yielded a corpus of transcribed text that was reviewed by three readers who extracted green behaviors mentioned by informants. The initial list of green behaviors mentioned by the 12 informants ran to 138 items. We extracted a list of 84 items by (1) collapsing duplicates ("turn in cans for redemption" and "recycle aluminum cans"); (2) choosing more general exemplars over more specific ones (choosing, for example, "don't litter" over "don't throw cigarette butts on the ground"); and (3) selecting just one exemplar from several that seemed to us to overlap (choosing, for example, just one of the pair "advocate saving the wetlands" and "advocate saving the rain forest").

We added one item of our own to the list: "buy an electric car" (item 85). At the time, engineers at Ford were working on two new cars: a fully electric model and a hybrid that would run on either electricity or gasoline. They wanted to know where — if at all — Americans placed these alternative cars in their domain of environmentally helpful things. As most Americans at the time had never heard the phrase "hybrid car" (it would be another eight years before Toyota introduced the first production-level hybrid car), we used "buy an electric car" in our list of environmentally friendly behaviors.

Table 1 shows the full list of 85 items extracted. We used these 85 items in a free pile sort task and a subset of 48 items (starred) in a successive pile sort task.

ID	Label	Description
1	Bin*	Use the recycling bins
2	Can	Turn in cans for redemption
3	Cop	Sell copper and brass to recycler
4	RstB*	Restore building instead of building new
5	Off*	Put containers around the office
6	Lngr	Use things longer
7	Bags*	Take your own bags to the grocery store

8	GivU*	Give used clothes and things to the Salvation Army or to someone else
9	BuyR	Buy things made out of recycled products
10	Litt*	Don't litter
11	Pick	Pick up paper you see on the ground
12	Oil*	Take oil and paint to toxic waste dumps or recycling centers
13	Spk*	Tell people when they do bad things to the environment
14	Pol	Participate in pro-environmental political activities
15	Slgn	Wear t-shirts that say, "Save the Earth"
16	Cng*	Write your congressman or congresswoman
17	Org	Support organizations that deal with world overpopulation
18	EncO*	Encourage others to recycle
19	Edu	Educate children about the importance of recycling
20	TchB	Teach people about the personal things they gain from a healthy environment
21	EncB	Encourage people to buy things made from recycled products
22	Spcs*	Educate children about endangered species
23	Prsrv	Teach kids to preserve the planet
24	Eg*	Show children how to be environmentally conscious
25	PubT*	Take public transportation
26	CarP	Carpool
27	Tun*	Make sure your car is running well
28	Bike	Ride a motorcycle
29	Eth	Use ethanol
30	OffW*	Turn off water between razor swipes while shaving
31	Twl	Reuse towels
32	Tlt	Install water-saving toilets
33	Fans*	Use fans instead of air conditioning
34	GasF*	Heat your home with gas instead of electricity
35	Aut	Set automatic timers to regulate household temperature
36	OffL*	Turn off lights
37	Meat*	Reduce your consumption of meat

38	Grdn*	Plant a garden
39	Cmp*	Learn how to compost
40	Pkg*	Avoid overpackaged products
41	Tree*	Plant and maintain trees
42	2side	Use both sides of a piece of paper when Xeroxing
43	Aero*	Don't use aerosol propellants
44	Wet	Advocate saving the wetlands
45	Ovn*	Make sure there are no cracks in the seal on your oven door
46	CldW	Use cold-water detergents on lightly soiled clothes
47	Lint	Clean the lint filter in your clothes dryer regularly
48	Line*	Use a clothesline for small loads like socks and underwear
49	Tol*	Set your thermostat higher in the summer and lower in the winter
50	Flour	Use fluorescent instead of incandescent bulbs
51	Watt*	Buy lower wattage light bulbs
52	Full*	Wash dishes only with full loads
53	Shrt	Use short cycles for everything but the dirtiest dishes
54	RnsC	Use cold water to rinse dishes before putting them into the dishwasher
55	OffAC	Turn the air conditioner off when you leave the house for several hours or more
56	Shd*	Close shades and drapes on hot days
57	Frdg*	Check the seal on your refrigerator door
58	CFC	Capture the CFCs in any old fridge before you junk it
59	Bfr*	Let warm leftovers cool before putting them in the refrigerator
60	Tmr*	Put outdoor lights on a timer or photocell control
61	Swt*	Wear sweaters in the house during the winter
62	Shwr*	Use a low-flow shower head
63	Duct	Insulate the heating and cooling ducts in your house
64	Fund*	Organize fund-raising drives to collect recyclables
65	Wthr	Weatherstrip around doors and windows
66	Cnv	Buy a convection oven rather than a standard model
67	Top*	Choose refrigerators with freezers on top rather than on the side

68	Air*	Look for a dishwasher with an air-dry setting
69	Blt	Choose a dishwasher with a built-in heater to boost the water temperature
70	Mst	Choose a clothes dryer with moisture sensors
71	Ins*	Make sure your home is insulated
72	Mlch	Let grass clippings turn into mulch
73	High*	During dry periods, cut the grass high to keep it from drying out
74	Nite	Water your lawn in the early morning or late afternoon
75	Lawn*	Use shrubs, succulents, and trees as substitutes for a lawn
76	Tire*	Keep your car's tires properly inflated to save gasoline
77	Fuel	Pay attention to the gas mileage when you buy a new car
78	Wlk	Walk or bike whenever you can to save gasoline
79	Dbl*	Use energy-saving double-pane windows
80	Furn*	Get your furnace tuned up
81	Dpr*	Use cloth diapers instead of disposable diapers
82	PprB*	Use paper bags
83	Tuna	Purchase only "dolphin-safe" tuna
84	Grp*	Join environmentalist groups (e.g., Environmental Defense Fund, National Resources Defense Council, Sierra Club)
85	Elec*	Buy an electric car

Table 1: List of 85 green behaviors extracted from the open-ended interviews. Starred items are used in the successive pile sort task

The Free Pile Sort Task

In conducting the pile sorts, we handed informants a deck of 85 cards. Each card had one item from the list in Table 1 printed on it. We asked informants to "please go through the deck and put things that seem to go together into piles."

Informants were told that they could not put all items into one pile (saying, for example, that "these items all go together because they are all about green behaviors"). They were told that they could make singleton piles for items that seemed not to go with any other item, but that they could not put each and every card into a separate, singleton pile (saying, for example, that "all these items are really different from one another.")

The free pile sort is easy to do and informants often report having fun doing it. The task can get tiresome when the list of items gets up to around 100, but our 85 items took between 15 and 25 minutes for people to sort. After informants completed the pile sort task, we interviewed them about why they placed items together in piles. This produced a number of potential themes for the domain and helped us in our interpretation of the multidimensional scaling plots, discussed below.

We conducted 44 free pile sorts: three in Los Angeles, 11 in Fargo, North Dakota, and 30 in Gainesville, Florida. We selected these locations entirely for convenience — that is, places where we had researchers on the spot who could collect the data. This would seem to violate all principles of sampling, but we were not testing for the distribution of independent features of people, but rather for the extent to which people share a domain of knowledge. If a cultural domain is widely shared, we should find it represented in diverse subgroups and across the geographic expanse of the society (Handwerker, Harris, Hatcherson 1997; Handwerker, Wozniak 1997).

Among the informants were 21 women and 23 men; 29 Whites, 14 African Americans, and 1 Hispanic. The average age of our informants was 34.6 (sd 10.5) and they had 14.8 years of education (sd 3.0). There was no statistical difference between the men and women on either age or education, but because of our location on university campuses, it was easiest for us to interview students and graduate students, who are overrepresented in our convenience sample for this task.

The Free Pile Sort Data

The free pile sort produces a three-dimensional matrix composed of a stack of item-by-item proximity matrices, one for each informant. The cells of each of these matrices contain a 1 or 0, indicating whether a pair of items was placed together in a pile by the informant. These individual item-by-item proximity matrices can be aggregated. The cells of the aggregate proximity matrix indicate the percentage of times that each pair of items was placed together in a pile by all the informants.

The data in each of the individual matrices indicate whether any two items are related in the mind of the informant who did the pile sort task. The aggregate proximity matrix provides a summary of how closely any two items are related in the minds of all the informants who did the pile sort task. The ANTHROPAC software package (Borgatti 1992b) provides a procedure for importing pile sort data and creating the matrices for analysis.

The Successive Pile Sort Task

Free pile sorts are subject to what is known as the "lumper-splitter problem." If you present a list of items in a cultural domain to a group of people, the so-called lumpers see a few large clusters while the splitters see many small clusters. In our free pile sort data, for example, three of our informants divided the cards into just three piles, whereas one person made 28 piles. Nine people made between 9 and 11 piles. Some people had no piles with just 1 item in it; others had 5 or 6 1-item piles.

Of course, one of the benefits of the free pile sort method is that it allows informants to tell us, with no restrictions, how they see the packaging of items in a cultural domain. The fact that some people see the universe of green behaviors as essentially of just three types is of interest. If we are interested only in the relations among a set of items, then the free pile sort method produces rich data easily. However, because of the lumper-splitter problem, it is difficult to compare the responses of individual informants to one another (Weller, Romney 1988: 26).

The successive pile sort produces a set of individual, item-by-item similarity matrices that can be compared to one another. Each matrix, in fact, contains information on a hierarchical clustering of the items for each informant.

We used a method developed by Boster (1994) to collect successive pile sort data. In this method, the informant does a free pile sort, producing, say, N piles. The informant is asked to collapse any two piles into a single pile, resulting in N−1 piles. Once two piles have been collapsed, the resulting group of items is considered a new pile. The process is repeated until there are just two piles left. Next, the informant goes back to the original free pile sort and splits any of the piles into two, creating N+1 piles. This process continues until there are only single items, each a separate "pile." Boster worked out a clever method of coding such data efficiently. Essentially, for each respondent, the ID numbers of all the items are written in a long string, with special "cut-codes" inserted at appropriate places to indicate that, at a certain level of clustering, the items to the left of the cut-code were more similar to each other than to those to the right of the cut-code. In this way, a complete hierarchy can be encoded into a single string of codes and read by a computer program such as ANTHROPAC.[1]

We asked 30 additional informants in Gainesville to complete a successive pile sort task. The successive pile sort task can be time consuming, so we cut the list of items down from 85 to 48. In what follows, comparisons of data from the free pile sort and the successive pile sort are based on the 48 items that the two tasks had in common. The starred items in Table 1 are the 48 items used in the successive pile sort task.

Methods of Data Analysis

The matrices produced by the initial free and successive pile sort tasks can be examined by a variety of methods for patterns.

1. Cultural consensus analysis examines whether there is a single cultural model driving the pile-sorting behavior of the informants.
2. Multidimensional scaling and cluster analysis look at how items in a cultural domain are packaged into subgroups and how those subgroups are related.
3. PROFIT, or PROperty FITting analysis, is a formal test of ideas about the forces that create subgroups of items in a domain.
4. The Quadratic Assignment Procedure, or QAP (Hubert, Schultz 1976), is a formal way to compare directly how similar two matrices are. This allows us to examine whether the item-by-item matrix of similarities produced by cultural subgroups (men and women, African Americans and Whites, etc.) are similar or different.

Cultural Consensus

We begin with a test of whether there is a cultural consensus among our informants about the 85 items in the pile sort task. The cultural consensus model, developed by Romney and colleagues, is a general solution to the problem of finding the correct answers to a test without having the answer key. (See Batchelder, Romney 1988, 1989; Romney, Weller, Batchelder 1986; and Weller 2007 for full discussion of the cultural consensus model.)

The model is based on the observation that experts in a domain of knowledge tend to agree more with one another about answers to questions than do non-experts (Boster 1986). Suppose we have a set of responses by students to a set of test questions. Each student's responses are a profile of that student's knowledge or competence with regard to the particular set of questions. We can create an agreement matrix among the respondents by computing a suitable similarity coefficient between all pairs of rows (students) in the matrix. The observed agreement matrix is then adjusted for chance agreement in order to estimate agreement due to common cultural knowledge. The matrix is then factored using a minimum residuals factor analysis routine (Comrey 1962).

Factoring yields a set of eigenvectors and associated eigenvalues, ordered from largest to smallest. By convention, a result in which the first eigenvalue is more than three times the size of the second is regarded as evidence of the existence of a dominant factor representing a single cultural "answer key." Under certain conditions (described below), the values of the principal eigenvector (commonly referred to as "factor loadings") can be interpreted as agreement with the cultural answer key, which is to say cultural competence or knowledge. Those who score high on this factor — the competent persons — are the ones who sort "correctly."

It can be shown mathematically that the model provides good estimates of cultural truth and competence whenever three conditions are met. Condition 1 is that there is a single cultural reality — a single culturally correct right answer for each question/task. For domains of knowledge that contain objective facts (baseball trivia, for example), there can only be a single culture. For other domains, different communities may have different culturally correct answers to the same set of questions or talks. For example, sport fishermen and commercial fishermen have well-established but different ideas about the same list of fish species (Boster, Johnson 1989). Fundamentally, Condition 1 is that all the respondents are drawn from the same culture.

Condition 2 is that informants try to give the culturally correct answer to each question in a test, and when they don't know, they guess in a way that is independent of others (e.g., they do not have access to the others' responses).

Condition 3 is that each person's competence level can be modeled as a single quantity. The implication of this is that all the questions in a cultural consensus test are taken from a single cultural domain. It violates the model to include questions about, say, the habits of local birds and, say, the features of local religious rituals as informants might have considerably more expertise in one domain than the other. In this case, at least two competence variables — one for each domain — would be needed to represent a person's expertise.

We tested the consensus model on a university course exam — that is, on data for which the answers are known. The model produced the right answer on all 60 questions; the correlation between the predicted competence of the 150 students in the class and the competence of the students as measured by comparing their exam responses to the instructor's answer key was .96.

Consensus Analysis of the Free Pile Sort Data

Technically, pile sort data violate Condition 2 of the consensus model, making the resulting estimates of individual competence unreliable as point estimates of knowledge. However, the method still allows us to examine the degree of consensus represented in the dataset, and measure the prototypicality of each respondent.

Ultimately, pile sort tasks result in data consisting of an NxN item-by-item proximity matrix for each respondent. In the case of free pile sorts, the individual proximity matrices are binary, with a "1" in cell (i,j) indicating that the respondent has placed item i in the same pile as item j. Effectively, the N^2 cells give the respondent's true / false answers to N^2 questions of the form "Is item i similar to item j?" However, because it is obvious that an item is similar to itself and that if item i is in the same pile as item j it is necessarily true that item j is in the same pile as item i, we submit only the $N(N-1)/2 = 85 \times 84/2 = 3570$ cells of the upper triangle of the proximity matrices to consensus analysis.

Applying the consensus model to the 44 upper-half individual proximity matrices from the free pile sort, the eigenvalue of the first factor is more than 11 times the size of the second and explains 88 % of the variance in the agreement matrix. This suggests that our 44 informants (Americans from quite varied backgrounds) share a mental model of the semantic organization of environmental behaviors.

In contrast to the free pile sort, the successive pile sort data consists of ordinal-scaled measures of the degree of similarity among items. Specifically, each cell of an individual proximity matrix gives the hierarchical level (between 1 and 47) at which a given pair of items was placed together in a pile. Applying the consensus model to the 30 individual proximity matrices from the successive pile sort, the eigenvalue of the first factor is 9.7 times the size of the second and explains 84% of the variance in the agreement matrix. This again points to the existence of a shared mental model of environmentally protective behaviors.

We can test directly the extent to which the results of the free pile sort task and the successive pile sort task are similar. Both tasks produce a set of individual proximity matrices, and both produce an aggregate proximity matrix as well. The cells of the aggregate matrix from the free pile sort contain averages of similarity, across all informants, for each pair of items. Thus, if 30 % of informants put two items in the same pile in a free pile sort, the similarity for the items is .30. For successive pile sorts, the similarity of a pair of items is the average level at which the pair was placed together across all informants.

The aggregate similarity matrix from the free pile sort data is 85x85, whereas that of the successive pile sort is 48x48. We therefore extract the 48x48 matrix of values from the 85x85 free pile sort matrix and compare this to the aggregate matrix from the successive pile sort. (To make sure that this does not do violence to the original data, we ran a consensus analysis of the free pile sort data, cut down to 48 items to match the successive pile sort data. This produces a first eigenvalue 9.8 times that of the second value, accounting for 88 % of the agreement matrix.)

The correlation between these two 48x48 matrices of associations is .854, indicating they are measuring the same thing. Running the consensus model on the free pile sort and on the successive pile sort data produces two suggested matrices of correct answers. (The matrix for the successive pile sort has real numbers in it as each individual proximity matrix is nonbinary.) The correlation for these two matrices is .695, which is high given that one variable has a range of interval-scaled values whereas the other is limited to zeros and ones.

Further Tests on the Stability of the Domain

Although the consensus analysis indicates that a single cultural answer key applies to the entire sample, it is still possible for there to be differences among subgroups of respondents. For example, it could be that, say, men are consistently lower in prototypicality than women. Given that, it is also possible that, analyzed separately, men's responses would not evince a great deal of consensus. To test this, we divide the set of 44 individual proximity matrices from the free pile sort task into appropriate subsets and run the cultural consensus model on those subsets.

Among the 30 Whites (including 1 Hispanic) who did the free pile sort task, the first factor accounts for 87% of the variance in the agreement matrix. Among the 14 African Americans, the first factor accounts for 88% of the variance in the agreement matrix. Furthermore, a test of the differences between the aggregate proximity matrices of Whites and African Americans, using the method of Borgatti (2002), showed no significant difference ($p = 0.873$).

In every comparison—African Americans and Whites, men and women, older (40 and over) and younger people, those with and those without a college education—the first eigenvalue is at least nine times bigger than the second and explains at least 86% of the variance in the pairs of agreement matrices. Further, the correlations of the aggregate proximity matrices for African Americans and Whites, men and women, those with a college education vs. those without, and those 40 or older with those younger than 40 are all extremely high (at least 0.730).

Overall, the strong cultural consensus in both the free pile sort and successive pile sort tasks; the stability of this replication in many subsets of the data; the stability of the consensus in the 48-item subset of the original 85-item free pile sort data; the strong, direct measure of similarity in the agreement matrices; and the overwhelming similarity in the aggregate proximity matrices derived from two radically different measures of association, all lead to the conclusion that *Americans from across the socioeconomic spectrum share a cognitive model of "what goes with what" when it comes to "things we can do to help the environment."*

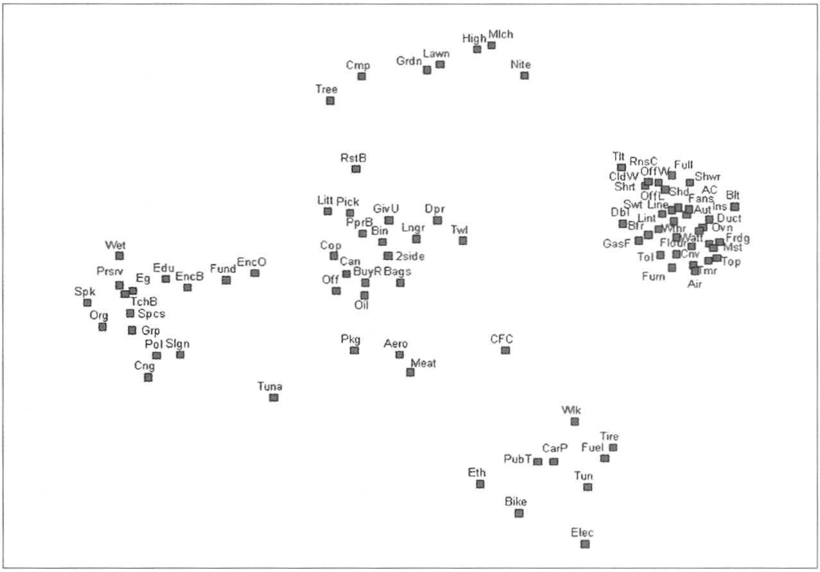

Figure 1: Nonmetric multidimensional scaling of 85 items sorted by 44 respondents

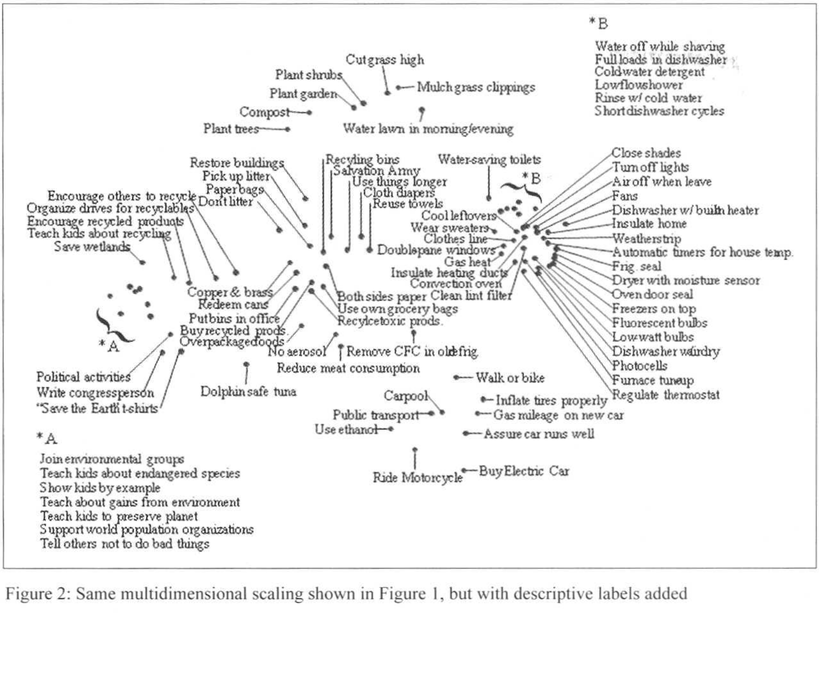

Figure 2: Same multidimensional scaling shown in Figure 1, but with descriptive labels added

Whether this cognitive, cultural model translates into behavior is another matter. From our interviews with informants about what they were thinking as they did their pile-sorting task, we suspect that the "green domain" reflects a general cognitive orientation in which behaviors are thought of as primarily work related, home related, or related to a generalized public. This conclusion is reinforced with the application of two additional analytic methods to our data: multidimensional scaling and hierarchical clustering.

Multidimensional Scaling

The strong evidence of a cultural consensus leads us to examine the properties of that consensus: How, exactly, do people organize the set of green behavior items in our tests? The set of relations among individual pairs of items is contained in the aggregate proximity matrices from the pile sort tasks. However, the pattern of relations among sets of items (sets larger than pairs) is impossible to comprehend by simply looking at the welter of numbers in such matrices. Patterns of relations, if they exist, can be discerned with multidimensional scaling and with cluster analysis.

Multidimensional scaling (MDS) maps the items' similarities (or dissimilarities) among a set of items onto Euclidean distances among a set of corresponding points in N-dimensional space (where N is specified by the investigator). Effectively, an MDS algorithm calculates the coordinates in space for each point such that the distances between the points correspond as closely as possible to some function of the input proximities. Plotting these points yields a graphical display of relationships among a set of items; it eliminates detail and lets the analyst focus on the big picture. Figure 1 shows the MDS plot of the aggregate 85x85 matrix produced by the free pile sorts of the 44 informants in our convenience sample. Figure 2 shows the same result, with descriptive labels added.

The goodness of fit of items in an MDS plot is measured in terms of stress. The relationship among any set of items can be plotted in N−1 dimensions with no stress — that is, without having to make any compromises on where exactly to place any item in relation to all other items. Because an 84-dimension plot is not interpretable, we try to plot the relations among all items in as few dimensions as possible. MDS programs report how much stress there is in a solution to this problem — that is, how much compromising was required to put all the items onto a single map.

As the number of items to be fitted grows, it becomes more and more difficult to achieve a low level of stress. Sturrock and Rocha (2000: 57–58) show that if a 30-object matrix is scaled in 2 dimensions and has a stress of 0.33, there is a 1% chance that the matrix has no structure — that is, that the objects are randomly arranged. With 85 objects scaled in 2 dimensions there is 1 % chance that the resulting graph has no structure if the stress reaches 0.39. From the strong, stable results of the consensus analysis, we expect low stress for an MDS plot and, in fact, the stress in Figure 1 is .152. In our experience, this is quite low, given N(N−1)/2, or 85(84)/2=3570 pairs of items to fit in 2 dimensions.

There may, of course, be more or fewer than 2 dimensions in these data. In this case, a 1-dimensional plot has a stress of .258, so the 2-dimensional stress of .152 is a 41 % improvement. At three dimensions, the stress is 0.116, a 23 % improvement; at four dimensions, the stress is 0.089, also a 23 % improvement. Given the adequacy of the 2-dimensional solution and the limitations of paper displays, we present only the 2-dimensional solution.

Cluster Analysis

The existence of clusters of environmental behaviors seems very clear in Figure 1 and matches what our informants told us about how they did the pile sort task. However, to guard against seeing patterns where none exist, we used cluster analysis. Two separate approaches were used: Johnson's (1967) hierarchical clustering, and a combinatorial optimization algorithm (Borgatti, Everett, Freeman 2002).

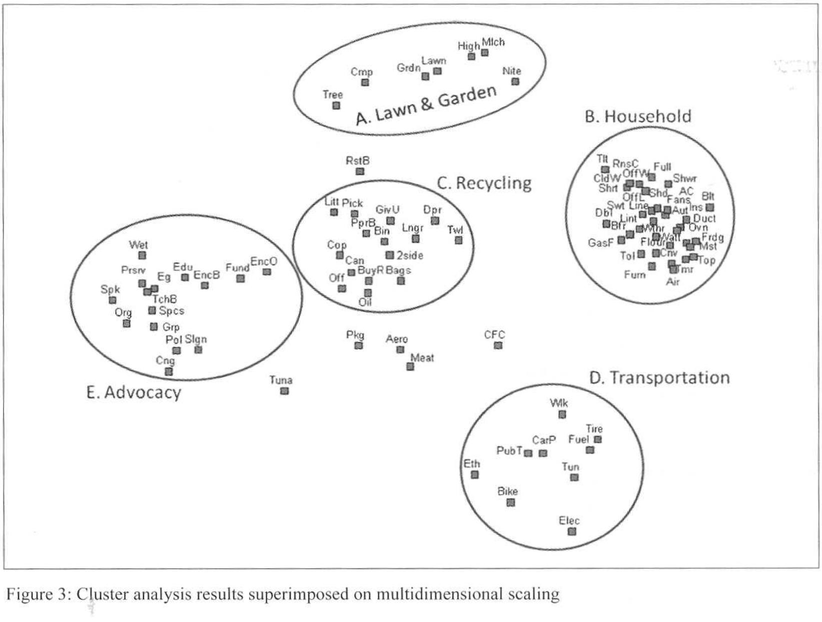

Figure 3: Cluster analysis results superimposed on multidimensional scaling

Like MDS, the input to cluster analysis consists of a matrix of similarity or dissimilarity coefficients — in our case, proportions of respondents placing pairs of items in the same pile. The combinatorial optimization approach seeks to maximize the correlation between the input similarity matrix and an idealized matrix Y in which $y_{ij} = 1$ if items i and j belong to the same cluster and $y_{ij} = 0$ if they belong to different clusters. The correlation is high when a clustering is found in which items in the same cluster are highly similar while items in different clusters have low similarity. By running a 2-cluster solution, then a 3-cluster solution and so on, a series of clusterings is obtained at varying levels of resolution.

Johnson's hierarchical clustering begins by assigning each item to its own singleton cluster. The algorithm then finds the pair of clusters that are most similar and joins them into a larger cluster. This process is repeated until all items belong to a single giant cluster. The result of this process is a collection of hierarchically nested partitions, ranging from the initial partition with N clusters, to the final partition with just 1 cluster. Typically, we are interested in a partition that has a moderate number of clusters — few enough to provide clarity and simplification of the data, but numerous enough so that the clusters are meaningfully tight.

Several variants of Johnson's basic method exist. In single-link clustering, the similarity between newly formed clusters is defined as the maximum similarity between any member of one cluster and any member of the other cluster. In complete-link clustering, the similarity between clusters is defined as the minimum similarity between their members. In the average method, the similarity between clusters is computed as the average similarity between members of the clusters.

For our analysis, we ran all three variants of Johnson's method, plus the combinatorial optimization method. What we found was that there were 5 clusters of items that remained together in all analyses, plus 6 individual items that were placed in different clusters by different procedures. A summary of these results is presented graphically in Figure 3.

As shown in Figure 3, there is a cluster on the right side of the picture that contains all 33 items that involve the home. Another cluster contains all 9 items that involve transportation. To the left are all the items that involve advocacy, gardening, and recycling. The "recycling" cluster contains the most central items; all are related to reusing things and to cleaning up the environment. The cluster labeled "advocacy" contains all the items related to teaching others about the environment and to getting involved in private and public (political) organizations related to the environment. The large cluster of items labeled "household" concerns things that can be done in the home and may be broken down into smaller clusters having to do with saving water vs. saving energy and having to do with behaviors related to the kitchen vs. behaviors related to other parts of the house.

PROFIT Analysis

So far, we have interpreted the MDS plot in terms of clusters. However, another approach to interpreting MDS plots is to look for gradients or underlying dimensions of variation. For example, in Figure 3, the items on the far left involve various kinds of advocacy behavior, and in that sense are highly public. In contrast the items on the right are more private. The items in the middle of the picture seem to us to be fairly public but more individualistic than the items on the far left.

Another possible dimension is concerned with whether the behavior has to do with natural versus manufactured things. For example, the cluster at the top of Figure 3 is composed of items that all deal with gardens and trees and composting; the cluster at the bottom involves transportation — cars, bicycles, and so on.

Our seeing dimensions (patterns), however, does not mean that informants were actually driven by those dimensions in answering questions about the similarity among pairs of items. We test our subjective judgments regarding these dimensions using a PROFIT (PROperty FITting) analysis (Chang, Carroll 1968).

Each item in an n-dimensional MDS plot is defined by as many coordinates as there are dimensions. In a PROFIT equation, the independent variables are the MDS plot coordinates; the dependent variable is the mean scale score, on a dimension of interest, for each item. If informants were, in fact, thinking in terms of the hypothesized dimensions, then the coordinates from an MDS representation would statistically account for the variance in scale scores for each item.

We asked different sets of 28–30 informants one of the following questions about each of the 85 items in the original pile sort list (see Appendix 2 for the full text of these questions):

1. How easy is it to do each of these things alone vs. needing everyone to pitch in (on a scale of 1–3, where 1 means it's easy for an individual to do alone)? (We call this COOPERATE in the analysis that follows.)
2. How public or private is each item (on a scale of 1–5, where 1 is very private)? (PUBLIC)

3. How often do you think people might do each of these things (on a scale of 1–4, where 1 is rarely)? (OFTEN)
4. How difficult is it for an individual to see the results of their behavior (on a scale of 1–3, where 1 means that an individual can't easily see the results)? (EASY)
5. How much is each of these items about conservation or pollution (on a scale of 1–4, where 1 is all about conservation and 4 is all about pollution)? (POLLUTE)
6. How natural or technological is each of these activities (on a scale of 1–3, where 1 is natural)? (TECH)
7. How easy is it to do each of these things alone vs. needing the government to make it happen (on a scale of 1–3, where 1 means that people can do it alone, without any government help)? (GOVT)
8. How much money do you think it takes to do each of these things (on a scale of 1–4, where 1 means very inexpensive)? (MONEY)
9. How much does each item contribute to helping the environment (on a scale of 1–3, where 1 means it doesn't help at all)? (CONTRIBUTE)
10. How efficient is each item in helping the environment (on a scale of 1–10, where 1 means it isn't at all efficient)? (EFFICIENT)

We begin our analysis of these attributes by constructing the 10x10 matrix of correlations among them, shown in Table 2. Correlations above 0.500 are in bold.

	Cooperate	Public	Often	Easy	Pollute	Tech	Govt	Money	Contribute	Efficient
Cooperate	1.000									
Public	**0.690**	1.000								
Often	−0.187	−0.163	1.000							
Easy	−0.201	−0.178	**0.629**	1.000						
Pollute	0.401	**0.627**	−0.248	−0.068	1.000					
Tech	0.029	−0.108	**−0.558**	−0.352	−0.029	1.000				
Govt	**0.715**	**0.529**	−0.275	−0.238	0.432	0.388	1.000			
Money	0.051	−0.153	−0.318	−0.253	−0.051	**0.797**	0.299	1.000		
Contribute	0.251	0.279	0.405	**0.540**	0.286	−0.270	0.203	−0.209	1.000	
Efficient	0.192	0.237	**0.532**	**0.599**	0.127	−0.337	0.095	−0.168	**0.751**	1.000

Table 2: Correlations among item attributes

A factor analysis of this correlation matrix suggests that the 10 attributes can be boiled down to 2 or 3 underlying factors. As can be seen in Table 3, the eigenvalues drop off sharply after the third factor and fall below the conventional threshold of 1.

FACTOR	VALUE	PERCENT	CUM %	RATIO
1:00	3.333	33.3	33.3	1.11
2:00	3.003	30	63.4	2.102
3:00	1.429	14.3	77.7	2.046
4:00	0.698	7	84.6	1.833
5:00	0.381	3.8	88.4	1.064
6:00	0.358	3.6	92	1.254
7:00	0.286	2.9	94.9	1.257
8:00	0.227	2.3	97.2	1.174
9:00	0.194	1.9	99.1	2.121
10:00	0.091	0.9	100	
Sum:	**10**	**100**		

Table 3: Eigenvalues from factor analysis of item attributes

Table 4 shows the varimax-rotated factor loadings for the 3-factor solution. Based on the factor loadings, the first factor consists principally of the attributes Efficient, Easy, Contribution, and Often, and was labeled "Efficacy." It essentially measures the extent to which each green behavior is easy to do, is often done, makes a strong contribution and is an efficient thing to do. The

	Factors		
Attributes	**Efficacy***	**Collective**	**Cost/Tech**
Efficient	**0.8797**	0.2151	−0.0765
Easy	**0.8244**	−0.2422	−0.1543
Contribute	**0.8169**	0.3432	−0.0659
Often	**0.7186**	−0.2949	−0.3379
Coop	0.0380	**0.8454**	0.0958
Govt	0.0211	**0.7614**	0.4521
Public	0.0070	**0.8906**	−0.1728
Pollute	−0.0016	**0.7485**	−0.0860
Money	−0.1125	−0.0448	**0.9217**
Tech	−0.2995	0.0164	**0.9029**

Note: First factor multiplied by −1 to simplify interpretation.

Table 4: Factor loadings

second factor consists largely of attributes Cooperation, Public, Government, and Pollute, and was labeled "Collective." The Collective factor measures the extent to which an item involves more than an individual's behavior. Finally, the third factor consists of just Money and Technology, which reflects the very high correlation between perceptions of how technological something is and how costly it is.

Variable	Multiple R	R-Squared	P-Value
Efficacy	0.299	0.089	0.027
Collective	0.827	0.683	0.001
Cost/Technology	0.404	0.163	0.003

Table 5: PROFIT results for the MDS shown in Figure 1

Table 5 shows the results of a PROFIT using the factor scores to explain the distribution of items in the perceptual space shown in Figure 1. The table shows that all three factors are related to the pattern of similarities, but only the Collective factor is strongly related ($r^2 = 0.68$). Figure 4 shows visually how these three factors relate to the pattern of perceived similarities.

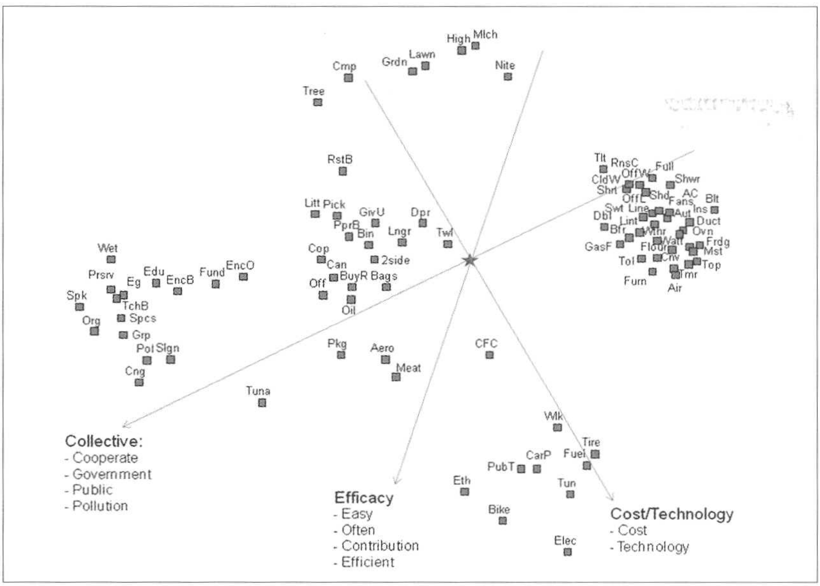

Figure 4: PROFIT results. As we move from top right to bottom left, items have larger scores on the Collective dimension

Discussion

We are dealing here with a small, statistically nonrepresentative sample of Americans. We are, however, dealing with cultural data. To the extent that culture is shared, each member of a society provides some window to the culture. Americans appear to agree strongly on what comprises the domain of green behaviors and, if our sample is any guide, gender, age, and education have little impact on how Americans categorize green behaviors. We conclude that there is a highly shared cognitive component of our culture that can be labeled the domain of green behaviors.

On the other hand, people in our sample do not use specifically green dimensions to think about green behaviors. Instead, they appear to think about green behaviors in terms of the objects and arenas to which behaviors relate (household, transportation, gardens, etc.). Thus, marketers and green advocacy groups have an opportunity to construct (through advertising and position papers) the conceptual space into which people can arrange green-related products or behaviors. Stakeholders of the green domain need to think about what dimensions they want their products to be compared on, and then teach people to use those dimensions. The results from our scaling questions on 85 green behaviors point to some possible dimensions.

For now, it is clear that some behaviors are widely regarded as easy for individuals to do alone, without any government intervention, without the application of a lot of technology, and without spending much money. These behaviors are also seen as efficient in terms of helping the environment. For example, car manufacturers might want to position electric and mixed fuel cars more closely with these efficient, easy-to-do behaviors. Also, the perceptual correlation between technology and cost may not be accurate, and could serve to impede adoption of technological solutions. Advocacy groups could work on reducing this perceptual correlation.

Appendix 1: Protocol for Semistructured Interviews

1. First, ask informant for a free list: What can people do to help the environment?
   Probe, if informant does not follow the question: What are some things that people can do if they want to help the environment?
   Probe: Anything else?

2. Take the list that you get from each informant after probing and ask:
   Do you do a, b, c… n (from each informant's list)?
   Why do you do a, b, c, … n?
   Why don't you do x, y …?
   Repeat probe: Is there anything else people can do?
   Repeat the "why do/don't you" questions for any new items.

3. What are some things that government can do to help the environment?
   Anything else? (probe until the list is complete)

4. Take the list that you get from each informant after probing and ask: Is the government doing enough about x?
   Why / why not?

5. What are some things that industries — big companies — can do about helping the environment?
   Anything else? (probe until the list is complete)

6. Take the list that you get from each informant after probing and ask:
   Can you think of some specific things that industrial firms are doing about x?
   Anything else? (probe until the list is complete)

7. Do you know people who you think of as environmentally conscious … you know, people who are really dedicated to doing things for the environment?
   Repeat for each person whom the informant names: So, how do you know that about them? what do they do? what do they say that makes you think they're into the environment?

8. Do you know anyone who you consider to be NOT environmentally conscious?
   Repeat for each person whom the informant names:
   How do you know that about them?
   What do they say? What do they do?
   For each person mentioned in 7 and 8, ask:
   How do you know this person/people?
   How close to you are they?
   Are these people part of a particular group of people?
   If asked about this last probe, then: you know, like the Sierra Club or Greenpeace or something like that.
   If so, what group? What would you call these types of people?
   If asked further about this: you know, what do you call people who belong to this kind of group?

9. What should we be teaching our kids about the environment?

10. People seem more conscious about the environment today than they used to be. Why is that? What do you think is really going on?

11. At the end of the interview, ask the informant's age, occupation, education, marital status, number of children, and where they live, and note their gender.

12. Finally, ask if the informant has anything he or she would like to add about environmental issues. What are the most pressing issues? Or aren't any of them really pressing? What should be done about each issue the informant names?

Appendix 2:
The Full Text of the 10 Questions Asked in Doing the PROFIT Analysis

1. Here is a list of things that people have told us they do in order to help the environment. Some of these things can be done by individuals alone, while other things require cooperation by everyone together. Please indicate, on a scale of 1 to 3, how easy it is for someone to do each of these things alone, where:
   1 = this is the sort of thing that anyone can do all by themselves if they want to
   2 = this is the sort of thing that takes some cooperation
   3 = this is the sort of thing that can only get done if everyone cooperates

2. Here is a list of things that people have told us they do in order to help the environment. Some of these things are more public behaviors (they take place outside the home) while others are more private (they take place inside the home). Please indicate, on a scale of 1 to 5, how public or private each item is, where:
   1 = very private (takes place entirely in the home)
   2 = more private than public
   3 = equally private and public
   4 = more public than private
   5 = very public (takes place entirely outside the home)

3. Here is a list of things that people have told us they do in order to help the environment. Some of these things are common behaviors, some are rare. Please indicate, on a scale of 1 to 4, how often you think people might do these things, where:
   1 = very rarely
   2 = somewhat rarely
   3 = somewhat often
   4 = very often

4. Here is a list of things that people have told us they do in order to help the environment. With some of these things, behaviors, you get to see the results of your own behavior right away, while with other behaviors the results might take a long time to see. Please indicate, on a scale of 1 to 3, how easy it is for an individual to see the results of their behavior, where:
   1 = it's impossible for an individual to see the results of this behavior
   2 = it may take some time, but eventually you get to see the results of this behavior
   3 = you get to see the results of this behavior immediately

5. Here is a list of things that people have told us they do in order to help the environment. Some of these behaviors are more about conservation of environmental resources, while others are geared more toward not polluting the environment. Please indicate, on a scale of 1 to 4, how much you think each of these items is about conservation or about pollution, where:
   1 = it's entirely about conservation
   2 = it's more about conservation than about pollution
   3 = it's more about pollution than about conservation
   4 = it's entirely about pollution

6. Here is a list of things that people have told us they do in order to help the environment. Some of these things are pretty natural, while others require a lot of technology. Please indicate, on a scale of 1 to 3, how natural or technological you think each of these activities is, where:
   1 = it's entirely natural
   2 = it takes some technology, but not much
   3 = it requires a lot of technology

7. Here is a list of things that people have told us they do in order to help the environment. Some of these things can be done by individual people, while other things can only be done by the government. Please indicate, on a scale of 1 to 3, how easy it is for someone to do each of these things alone, where:
   1 = this is the sort of thing that people can do by themselves if they want to
   2 = this is the sort of thing that takes some cooperation by the government
   3 = this is the sort of thing that can only get done if the government does it

8. Here is a list of things that people have told us they do in order to help the environment. Some of these things are pretty inexpensive, while others take a lot of money. Please indicate, on a scale of 1 to 4, how much money you think it takes to do each of these things, where:
   1 = it's very inexpensive
   2 = it takes a little money, but not much
   3 = it's kind of expensive
   4 = it's really expensive

9. Here is a list of things that people have told us they do in order to help the environment. Please indicate, on a scale of 1 to 3, how much you think each item contributes to helping the environment, where:
   1 = it doesn't really help at all
   2 = it helps a little
   3 = it helps a lot

10. Here is a list of things that people have told us they do in order to help the environment. Please indicate, on a scale of 1 to 10, how efficient you think each item is in terms of helping the environment, where:
    1 = it isn't at all efficient
    5 = it is somewhat efficient
    10 = it is very efficient

Note

1. ANTHROPAC 3.2, available free on the web, has an option for importing successive pile sort data in this compressed format. Later versions of the program require the user to enter the sorts in a simpler but less efficient manner.

References

Batchelder, W. H. and A.K. Romney 1988: Test theory without an answer key. Psychometrika 53: 71–92.

Batchelder, W. H. and A. K. Romney 1989: New results in test theory without an answer key. In: E. E. Roskam, ed. Mathematical psychology in progress. Berlin: Springer-Verlag: 229–248.

Borgatti, S.P.

__ 1992b: ANTHROPAC 4.0. Columbia, SC: Analytic Technologies.

__ 2002: A statistical method for comparing aggregate data across a priori groups. Field Methods 14: 88–107.

Borgatti, S. P., M. G. Everett, and L. C. Freeman 2002: UCINET for Windows: Software for Social Network Analysis. Cambridge, MA: Analytic Technologies.

Boster, J. S.

__ 1986: Exchange of varieties and information between Aguaruna manioc cultivators. American Anthropologist 88: 428–36.

__ (ed.) 1987: Intracultural Variation. Special Issue of the American Behavioral Scientist 31(2).

__ 1994: The successive pile sort. Cultural Anthropology Methods Journal 6(2):11–12.

Boster, J. S. and J. C. Johnson 1989: Form or function: A comparison of expert and novice judgments of similarity among fish. American Anthropologist 91: 866–889.

Chang, J. J. and J. D. Carroll 1968: How to use PROFIT, a computer program for property fitting by optimizing nonlinear or linear correlation. Murray Hill, NJ: AT&T Bell Laboratories.

Comrey, A. L. 1962: The minimum residual method of factor analysis. Psychological Reports 11: 15–18.

Handwerker, W. P., J. Harris, and J. Hatcherson 1997: Sampling guidelines for cultural data. Cultural Anthropology Methods 9(1): 7–9.

Handwerker, W. P. and D. F. Wozniak 1997: Sampling strategies for the collection of cultural data: An extension of Boas's answer to Galton's problem. Current Anthropology 38: 869–875.

Herndl, C. G. and S. C. Brown 1996: Green Culture: Environmental Rhetoric in Contemporary America. Madison: University of Wisconsin Press.

Hubert, L. and J. Schultz 1976: Quadratic assignment as a general data analysis strategy. British Journal of Mathematical and Statistical Psychology 29: 190–241.

Johnson, S. C. 1967: Hierarchical clustering schemes. Psychometrika 32: 241–253.

Kempton, W., J. S. Boster, and J. A. Hartley 1995: Environmental Values in American Culture. Cambridge, MA: MIT Press.

Romney, A. K., S. C. Weller, and W. H. Batchelder 1986: Culture as consensus: A theory of culture and informant accuracy. American Anthropologist 88:313–338.

Sturrock, K. and J. Rocha 2000: A multidimensional scaling stress evaluation table. Field Methods 12: 49–60.

Weller, S. C. 2007: Cultural consensus theory: Applications and frequently asked questions. Field Methods 19: 339–368.

Weller, S. C. and A. K. Romney 1988: Systematic Data Collection. Newbury Park, CA: Sage Publications.