Theoretical Rotation as a Tool for Identifying Points of Leverage in People's Perspectives for Program Improvement

Brett Kramer, PhD
Iowa State University
Virginia Gravina, Ph.D.
University of Uruguay

Abstract: *This paper's main objective is to provide a specific example of a research context using Q methodology in which theoretical rotation (also referred to as judgmental, geometric, or hand rotation) was justified and pursued. The paper specifically illustrates 1) how the authors determined theoretical rotation criteria; 2) the process by which these criteria guided the rotation; and 3) why this was more statistically, theoretically, and pragmatically satisfying than using varimax rotation. The case focused on the social, economic, and contextual reasons why some farmers in Uruguay declined to participate in a dairy herd improvement project, called the genetic registry. Q methodology was used to cast non-participating farmers' perspectives in relation to those of program planners. Because the unrotated factor matrix supported program planners loading on the same factor, theoretical rotation was used to retain as many program planners as possible on the same factor. By following this rotational scheme, one functional perspective was most heavily populated with program planners: the result was a data solution that contrasted the program personnel's viewpoint with that of the other three views that emerged in the rotation, all of which were populated entirely by farmers. Practical implications point to the suitability and power of theoretical rotation versus varimax rotation in Q methodology when the P-set "matters." That is, it matters when Q methodology is used intentionally to keep one set of respondents on the same factor in order to contrast their shared perspective with other attitudes that emerge in the study. The result is contrasting functional perspectives and the identification of leverage points between the views that represent points of convergence and divergence.*

Introduction

According to the International Dairy Federation, world milk production was forecasted to exceed 501 million tons in the year 2002 (International Dairy Federation 2002). In 2001, Uruguay produced 1.2 million tons of fresh milk with approximately 350,000 cows. In 1993, the Instituto Nacional para

Authors' Addresses: Kramer, Iowa State University, Ames, IA 50011; e-mail: brett.kramer@1answersolutions.com. Gravina, Department of Statistics, College of Agriculture, University of Uruguay, Garzon Avenue 780, Montevideo, 12.900 Uruguay; e-mail: virginia@fagro.edu.uy.
Operant Subjectivity, 2004 (April), 27 (3), 125-144.

Mejoramiento Lechero (INML) was formed in Uruguay to help improve the dairy industry through a genetic registry. "INML" translates from Spanish to the "Institute for Dairy Herd Improvement" and is similar to its North American counterpart, the Dairy Herd Improvement Association (DHIA). The genetic registry entails recording individual-level production data from herds with the expectation that farmers will use the data to make better production decisions, specifically those related to culling (removing) less productive cows. This paper describes a program evaluation of the genetic registry project.

The evaluation was expected to shed light on non-participation. In 2002, INML had approximately 200 dairy herds registered out of the roughly 6,000 dairy herds in Uruguay. Although INML had managed to attract the involvement of many large farmers and a scattering of medium to small-sized dairy farmers, more widespread participation, particularly from operations with fewer than 100 head, had eluded them. The evaluation focused on persons about whom program planners had questions: those farmers who had never enrolled in the genetic registry project. The evaluation question became: *Why had dairy farmers in Uruguay decided to forego participation in the genetic registry project?*

The authors chose Q methodology to answer the program evaluation question because of its power in revealing the functional divisions of perspectives within an issue of communicability (Brown 2002). In this case, the issue dealt with reasons behind farmers' lack of participation in the genetic registry project. Furthermore, it was hoped that Q methodology could identify a factor populated largely by program planners and other factor(s) populated largely by non-participants. Theoretical rotation was anticipated to draw attention to these other factor(s); factor(s) that represented perspectives that might otherwise be ignored by program planners. Privileging perspectives by role (farmer versus planner) could also serve a more practical purpose: identifying ideas for improving the program based on consensus items shared among the factors.

The purpose of this paper is to illustrate the suitability and power of theoretical rotation *versus* its varimax counterpart under specific conditions of use. It is not the intent, direct or otherwise, to argue for the use of theoretical rotation in every research context or to denounce varimax rotation. The authors hope to clarify regarding where and when theoretical rotation may prove useful in answering research questions posed by a study. The discussion provides a concrete example of when, why, and how theoretical rotation was used in the Uruguayan evaluation.

Methods

The authors and INML program planners identified both program participating technicians and non-participating producers to interview. The concourse was developed from interviews with one dairy cooperative administrator, three technicians (defined as professionals employed to counsel farmers on management decisions), and four dairy farmers (none of whom had participated in the genetic registry project). All interviews were transcribed in the speakers' native language (Spanish) and coded according to emergent and theoretical themes.

The Fisherian structure developed for use in this study consisted of two main effects, each with two levels, thereby resulting in the 2x2 matrix displayed in Table 1. The two main effects dealt with pressure (economic pressure and social pressure) and perspective (that of the farmer and that of planner), resulting in four cells that structured and organized the Q sample. Eight statements from each of the four cells in Table 1 were selected, resulting in a Q sample of 32 statements. All statements were derived directly from the qualitative interviews and required little, if any, editing (for the purposes of this paper, the statements were translated into English).

Table 1: Fisherian Structure of the Uruguayan Q Sample

Main Effects	***Levels***	
Pressures	Economic (*a*)	Social (*b*)
Perspectives	Farmer (*c*)	Planner (*d*)
Total cells	**ac + ad + bc + bd = 4 cells**	

The Q sample was submitted to 27 individuals for sorting. Farmers were asked to sort the statements according to the following condition of instruction: "Please sort the following 32 statements according to why you have not participated in the genetic registry project with INML." In the case of program planners, the condition of instruction was: "Please sort the following 32 statements according to why you believe *farmers* have not participated in the genetic registry project with INML." Respondents were first instructed to read through the sample and divide it into three piles in the context of their lack of participation: statements they most strongly rejected, statements that were not relevant to their perspective, and statements they most strongly endorsed. Once this stage was complete, all respondents were asked to arrange the 32 cards in the quasi-normal distribution (represented in Table 2), starting from the tails of the distribution and working towards the center.

Table 2: Q-set Sorting Distribution

-4	**-3**	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**
2	3	4	4	6	4	4	3	2

Of the 27 respondents who sorted the Q-set, 20 were farmers who were not enrolled with the INML project or any other similar project; the other 7 were program personnel (planners, technicians). It is important to reiterate that the reason for choosing such a *P*-set was to situate non-participants' perspectives in relation to those of program planners. Because evaluation practice is intended to improve programs, analyzing the data to make them clearer and more understandable for those responsible for the intervention (i.e., program planners) was deemed essential. This point cannot be overemphasized, because it formed the foundation for the theoretical rotation in the analysis. Leonard Barchak (2003, 72) notes, "If you merely want to establish the existence of factors, any person or persons will do. ... But if you have practical problems to solve, you may want to try to acquire the viewpoint of quay [key] individuals. ... ."

After the data were gathered, the Q sorts were analyzed with the assistance of the software package PCQ® for Windows, Academic Version 1.4 (Stricklin and Almeida 2000). The sorts were first correlated, and then submitted for factor analysis. Two methods of factor analysis are most widely marshaled for this task: centroid and principal components. Of the two, principal components is the most recognized and frequently employed method of factor extraction. However, as Stephenson (1953) and Brown (1980) have noted, the power of the centroid method is its flexibility. There exists debate within the Q community over this issue, despite Stephenson's strong theoretical arguments in support of the centroid method.

Centroid factor extraction uses an average correlation estimate (on average, the correlation between the sort under scrutiny and all others) to place on the diagonal of the inputted correlation matrix. This allows the researcher to pursue theoretical hunches, for it does not *require* a determinant solution. Principal components analysis (PCA), on the other hand, assumes a perfect inter-sort correlation estimate (1.0) to place on the diagonal of the inputted correlation matrix. It is hypothesized here, based in no small part on the authors' statistical training, that this assumption may well be the source of the often-cited eigenvalue criteria for factor retention. That is, one reads in the literature (see Everitt and Dunn 2001; Gable and Keilty 1993; Kim and Muelle 1978) that the number of factors to retain can be based on those factors with eigenvalues greater than 1.0. When one considers that in PCA, 1.0 is placed on the diagonals, it is discernible (and justifiable) where this criterion arises: no factor should be retained that cannot serve to "explain" at least one variable.

In R-methodological studies, it is variables (representing tests or characteristics) that are reduced via factor analysis. If a factor — which is supposed to function "better" than a single variable by explaining a linear combination of several variables — does not have an eigenvalue greater than 1.0, the factor is essentially "explaining" less than one variable. In this case, the researcher would be better served to use the variable in place of the factor, for the factor has done little to reduce the data and thereby accomplish the correlation; therefore, the number that is placed on the diagonal varies within and across each study according to the number of Q sorts. That is, if one additional Q sort were added, all of the numbers on the diagonals potentially would change; whereas with PCA, 1.0 is placed on the diagonal in every single instance, regardless of the number of Q sorts added or deleted.

In Q methodology, factor extraction is followed by factor rotation. Rotation consists of changing the reference points of the geometric coordinate system to more closely fit the data. The criteria for fit vary, however. Many rotation techniques, with their attendant criteria, are addressed in the literature. Two sets of criteria of which the readers might be aware are *simple structure* and *theoretical structure*. These are guidelines to rotation that are distinct in what they privilege in the rotation process. *Simple structure* refers to a situation in which Q sorts of all individuals are maximized on one factor with near-zero loadings on all others, thus enhancing clarity of the results (McKeown and Thomas 1988). *Simple structure* can also be thought of as a clean structure, for its criteria give priority to removing confounding sorts while simultaneously accounting for the greatest number of sorts in as few factors as possible. In other words, the rotational scheme should "tidy things up" so that sorts are in their proper place. Those that do not easily fit into the solution are minimized.

Another set of criteria that serves to focus the researcher in factor rotation is known as *theoretical structure*. *Theoretical structure* employs the researcher's ideas about what is important in the rotation task. That is, *theoretical structure* is pursued because the researcher has specific theoretical hunches and hypotheses to test (Brown 1980). More important here than "cleaning up the data" is the testing and probing of the data for possible explanations to propositions formulated with respect to specific theory. In the current example of dairy farmers and program planners, the intent was to harness Q methodology's power to illuminate similarities and differences between program planner and non-participant perspectives with regard to non-participation. Simple structure and theoretical structure are *guidelines* for rotation — not rotation *techniques*.

In *Q*, there are two main rotation techniques: *varimax rotation* and *theoretical rotation* (also called judgmental, geometric, or hand rotation). It is worth noting that varimax rotation, at least in the journal *Operant Subjectivity*, appears to be the method of choice: in perusing volumes 24 and 25 of the journal, varimax rotation was chosen five to one over theoretical rotation. The purpose of this paper is to illustrate the way in which a less common approach to rotation (*theoretical*) yielded more meaningful results.

A brief aside about the two methods is in order before continuing. *Varimax rotation* dictates that one "best" solution exists for the rotation of factors. This solution is based upon a well known mathematical principle called *ordinary* *least squares*. Varimax rotation proceeds by searching for, and finding, the solution that minimizes the sum of the squared differences between the data and the vector represented by the factor. While this carries with it wonderful mathematical (and statistical) properties, it does not *necessarily* carry wonderful practical or interpretive properties. With Varimax, the researcher is left with a single set of results, without regard to whether those results enlighten the phenomenon or answer the research question in a meaningful way. Furthermore, because varimax rotation is determined by a mathematical property, theoretical properties are left unaddressed.

Theoretical rotation, does not have the convenient mathematical or statistical properties of varimax. This lack, however, is more than compensated by its flexibility, which permits the researcher to find the best explanation to the data, rather than the most statistically satisfying one.

Results

The researchers first determined the extent to which program planners (Q sorts 21 through 27 in all subsequent tables) loaded on a common factor in the unrotated factor matrix. A guiding rule was used: *If program planners loaded on a common factor, it could be reasoned that their individual perspectives had common functional roots, different from others in the study.* Provided program planner perspectives had common functional roots, a rotation procedure keeping the program planners together on the same factor could be justified and supported. Other factors that emerged in the study could then be contrasted more easily with the program planner perspective. This would result in a solution that answered the evaluation question and provided insight into possible strategies to increase participation in the project.

The unrotated factor matrix (Table 3) was examined to determine if the seven program personnel loaded on a common factor. Five had loadings that were highly correlated with the same factor (A). Although not all of these reached statistical significance ($r > 0.46$, $p = 0.01$), they were meaningful enough to warrant keeping them on the same factor during rotation. The unrotated factor matrix appeared to support three or four factors reasonably well, while three other factors had only one loading each. The remaining two factors (not shown) had no meaningful or statistically significant sorts correlated with them. In fact, the two loadings on Factors D and E did not reach the threshold for statistical significance, hence it might be argued that the unrotated matrix supported the existence of a maximum of five factors.

Varimax Rotation

Prior to theoretical rotation, varimax solutions were estimated to compare to the theoretical rotation that would be pursued. Many times, a theoretical solution is similar to a varimax solution (Brown 1993). Theoretical and varimax solutions are not mutually exclusive; both can be pursued in no particular order. At some point, however, it does become necessary for the researcher to choose which solution provides the best explanation for the data.

In this instance, however, the varimax solutions produced disappointing results. The researchers chose to compare three-, four-, and five-factor varimax solutions based, in part, on what the unrotated factor matrix appeared to support. Table 4 provides a summary of the three varimax rotation solutions by listing which factor each sort loaded on in the three different solution schemes (i.e., three, four, and five factors).

Table 3: Unrotated Seven-Factor Matrix

Q Sorts	***Factors***						
	A	**B**	**C**	**D**	**E**	**F**	**I**
1	53						
2	62	62					
3*							
4*							
5	53			-41			
6	56					46	
7	43	63					
8*							
9		-57					
10*							
11						41	
12		-54					
13*							
14*							
15	41						
16							48
17*							
18			45			42	
19			44		41		
20	61		44				
21*							
22	58						
23	45						
24	41	40					
25						52	
26	59						
27	60						

Only loadings >0.40 shown; decimals are omitted.

* *Loading nonsignificant ($\alpha = 0.01$).*

Table 4: Varimax Factor Solutions Comparison

Q Sorts	***Factor Loading by Solution Type***		
	3-factor	**4-factor**	**5-factor**
1	B	D	D
2	A	A	A
3	*	*	*
4	*	*	*
5	B	B	B
6	A	A	A
7	*	A	A
8	*	D	D
9	B	B	D
10	*	*	*
11	*	*	*
12	C	C	C
13	*	*	*
14	*	B	*
15	A	A	A
16	*	*	*
17	*	*	*
18	C	C	C
19	C	C	C
20	*	D	D
21	*	*	E
22	A	D	D
23	*	*	E
24	C	A	A
25	*	*	*
26	A	A	A
27	B	D	D
Significant loadings	**13**	**17**	**18**

* *Loading nonsignificant ($\alpha = 0.01$).*

From careful inspection of Table 4, Factor A appears to be quite stable with respect to *who* loads on it, across all three factor solutions, as does Factor C. Factors B and D (when applicable), however, display less stability with respect to the individuals loading on these factors across the three-, four-, and five-factor varimax solutions. Factor A and C also exhibited strong item stability across all three solutions: very few items changed their place in the factor array. This means that Factors A and C in the three-factor varimax solution are the same Factors A and C present in the four- and five-factor varimax solutions. In each of the other factors, however, the meaning of the factor (each item's factor score, or each item's place in the factor array)

Table 5: Theoretical Factor Matrix

Q Sorts	Factors A	B	C	D	Σ
1*					
2	86				
3*					
4*					
5			-54		
6	68				
7	57				
8*					
9		-71			
10*					
11				53	
12		-68			
13*					
14*					
15	52				
16*					
17*					
18			66		
19			75		
20		-72			
21*					
22	56				
23	50				
24	48				
25				51	
26	68				
27	47				
Sig. loadings	**9**	**3**	**3**	**2**	**17**
% variance	**16**	**10**	**8**	**5**	**39**

Only loadings > 0.46 shown; decimals are omitted.
** Loading nonsignificant (α = 0.01).*

changed substantially across the three different solutions. Moreover, Factors B, D, and E (where applicable) bear little resemblance *to one another* across the different solutions. Of particular concern is the location of the program planners (sorts 21 through 27). Because varimax solutions are determined entirely along mathematical criteria, they do not offer the flexibility to maintain as many Q sorts as possible on the same factor. For this reason, statistical based rotations do not preserve the essence of the natural phenomena hinted at in the unrotated factor matrix.

Theoretical Rotation

It is especially for situations when varimax rotations do not lead to satisfying results that theoretical rotation is compelling. Table 5 lists the results from the theoretical rotation undertaken according to the following principles, listed in order of importance:

1) Maintain as many of the seven program personnel as possible on the same factor.
2) Account for the greatest number of sorts in the fewest factors.
3) Eliminate confounded (dual-loading) sorts.

From Table 5, a suitable result from the theoretical rotation was a four-factor solution, accounting for 17 of the original 27 sorts and 39% of the variability in the original 27×27 correlation matrix. Factor A contained nine significant sorts and explained 16% of the variability; Factor B held three sorts and 10% of the variability; Factor C had three sorts and 8% of the variability; and finally, Factor D consisted of two sorts and explained 5% of the variability. None of the 27 sorts was confounded after theoretical rotation, although several had high (but not statistically significant) loadings on more than one factor. More importantly, five of the seven program personnel were retained on Factor A, thus preserving the "naturalness" found in the unrotated factor matrix, as well as supporting the reason for undertaking the study at the outset. That is, the researchers now had obtained a composite factor largely populated by program planners that could be used to contrast their perspective with that of farmers.

Figure 1 shows Factors A and B in factor space before theoretical rotation. Of particular note, Q sorts 21, 23, 24, and 27 do not reach the level of statistical significance (0.46, $p < 0.01$), indicated by their location below the upper dotted line. Factors A and B were rotated approximately 28 degrees clockwise in three rotations to arrive at the final factor solution illustrated in Figure 2. In Figure 2, Q sorts 23 and 24 are now correlated with Factor A above the level deemed statistically significant, while the other program planners originally loading on Factor A are retained. Figure 2 corresponds to the final theoretical solution matrix detailed in Table 5 and is useful for *locating* the program personnel factor in factor space.

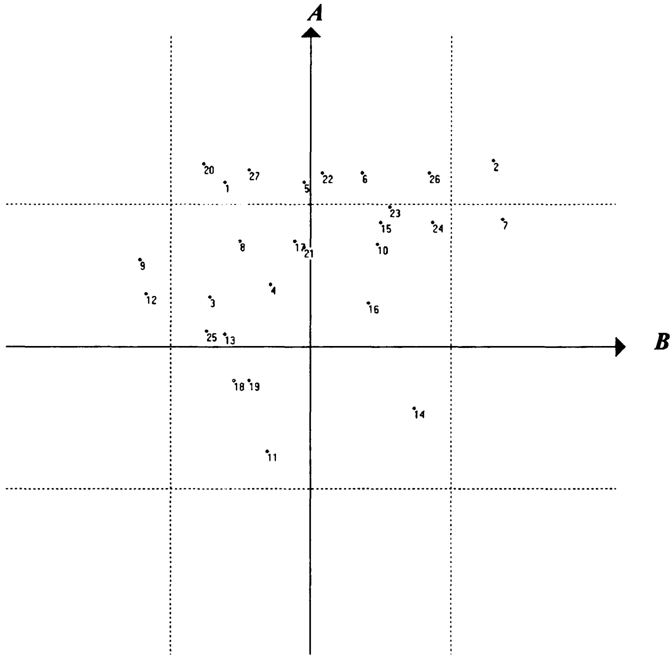

Figure 1: Unrotated Factors A and B in Factor Space

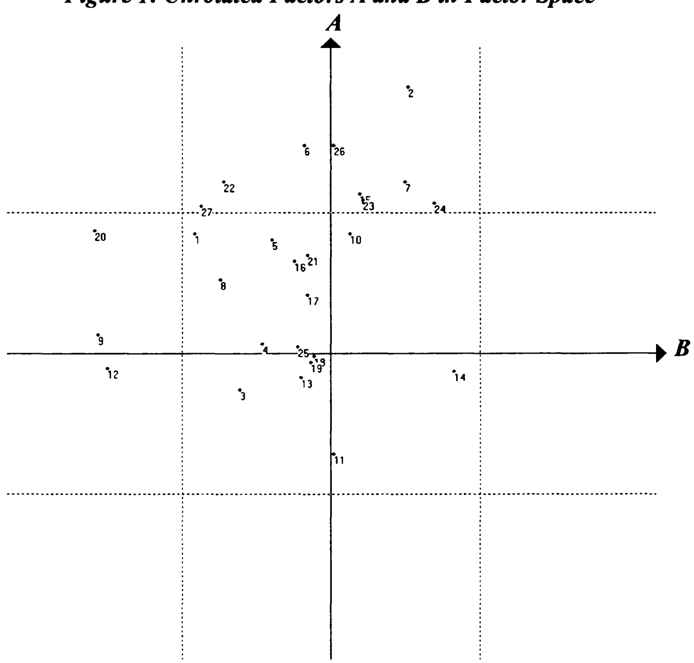

Figure 2: Rotated Factors A and B in Factor Space

Before going further, it is useful to compare the four-factor varimax solution to the one derived from theoretical rotation (see Table 6). In many ways, the solutions are similar. Both solutions resulted in 17 of the 27 persons loading on one of the four factors, and Factor C is reasonably similar across both solutions. However, beyond that, there are striking differences. It is particularly important to attend to the loadings of sorts 21 through 27. In the varimax solution, four of the seven sorts loaded across two factors, A and D. Additionally, Factors A and D in the varimax solution were correlated in the amount of 0.35, while Factors B and D shared a substantial degree of correlation in the amount of -0.45. Under the theoretical rotation solution, however, Factor A held five program planners; Factor D was populated by only one program planner; and the degree of correlation between the two factors was reduced to -0.28 (the highest correlation between factors in the theoretical rotation scheme).

Factor Interpretation

After rotation, a Q analysis generally proceeds to factor interpretation. Factors with significant Q sorts are analyzed in terms of their item scores and the relative placement of items within and across all the other factors. Because the main purpose of this paper is methodological and not necessarily phenomenological, little space will be spent on factor interpretation. However, knowing that readers of *Operant Subjectivity* consistently enjoy learning about the results of Q studies, brief factor interpretations and the respective factor arrays are presented. Moreover, some summary explanation of factors will add to the discussion section concerning the practicality of theoretical rotation.

Factor interpretation as presented here was confirmed and found accurate in follow-up interviews with factor exemplars during August 2003. Moreover, when questioned about the Q sample, interviewees indicated without exception that they thought the sample to be complete and accurate; they could think of no opinions or statements to add to the sample to make it more representative, and they indicated that the present sample was reflective of "their voice."

Factor A: The Technicians

Factor A (see Figure 3) was characterized by a focus on the technical approach to programming with a rejection of low milk prices or international policy as explanatory reasons for the lack of farmer participation. As stated previously, five of the seven program personnel loaded on this factor; however, four farmers joined these five to further define the factor. Furthermore, the sort most highly correlated with the factor was that of a farmer. The Technicians viewed technology as a way out of economic depression and with the assistance of experts, a way to increase enrollment and use of dairy genetic registry procedures. Practical implications suggested participation among farmers would increase if the program worked through technicians and farmers would be more likely to participate if it were clear experts would assist and train them.

Table 6: Varimax and Theoretical Factor Solutions

Q Sorts	*Factor Loading by Solution Type* Varimax	Theoretical
1	D	*
2	A	A
3	*	*
4	*	*
5	B	C
6	A	A
7	A	A
8	D	*
9	B	B
10	*	*
11	*	D
12	C	B
13	*	*
14	B	*
15	A	A
16	*	*
17	*	*
18	C	C
19	C	C
20	D	B
21	*	*
22	D	A
23	*	A
24	A	A
25	*	D
26	A	A
27	D	A

** Loading nonsignificant ($\alpha = 0.01$).*

-4	-3	-2	-1	0	+1	+2	+3	+4
19	13	1	15	4	2	5	9	7
26	31	16	17	6	3	27	12	10
	32	23	21	8	11	28	14	
		25	30	20	18	29		
				22				
				24				

Figure 3: Factor A Array

Factor B: The Efficiency Activists

Factor B (see Figure 4) endorsed efficiency in the industry. This perspective rejected social forces (such as competing organizations) as an explanation for the lack of farmer participation. They felt, rather, that the way to recruit more farmers into the project was to make the entire system more efficient – from the program throughout the supply chain. Although the Efficiency Activists did not reject technology, it wasn't their focus.

-4	-3	-2	-1	0	+1	+2	+3	+4
3	15	4	13	6	1	10	5	11
8	23	14	16	7	2	18	9	26
	32	27	24	12	17	19	25	
		30	31	20	18	22		
				21				
				29				

Figure 4: Factor B Array (reflected)

Factor C: The Traditionalists

Factor C (see Figure 5), the Traditionalists, was a bi-polar factor with two sorts on the positive pole and one sort on the negative pole. The positive pole was much more strongly defined: the two sorts were correlated with the factor at 0.66 and 0.75 respectively, while the sort negatively correlated with the factor was -0.54. The Traditionalists was a perspective that resoundingly rejected technical assistance and training. The perspective emphasized both independence and cynicism. The cynicism is identified, in part, by a solution endorsed at the positive end of the continuum; mostly, however, solutions were rejected. Traditionalists rejected both structural and political remedies to increase enrollment.

-4	-3	-2	-1	0	+1	+2	+3	+4
7	1	13	11	3	12	4	19	2
14	5	15	20	6	18	10	21	17
	29	16	22	8	24	26	31	
		32	25	9	28	30		
				23				
				27				

Figure 5: Factor C Array

Factor D: The Economists

Factor D (see Figure 6) was difficult to interpret. The Economists were somewhat focused on dairy/milk prices as the motivating force behind their personal lack of involvement. However, despite the fact that price appeared to dampen their enrollment in the project, the solution had more to do with social forces, such as working with other organizations and training farmers.

-4	-3	-2	-1	0	+1	+2	+3	+4
2	14	6	8	3	1	5	10	21
7	22	9	11	12	4	17	29	26
	31	15	20	13	16	18	32	
		27	28	19	24	23		
				25				
				30				

Figure 6: Factor D Array

Discussion

The evaluation question dealt with understanding why dairy farmers in Uruguay had not participated in a project. Program planners wanted to understand the perspectives of non-participants in order to increase enrollment. The rotation criteria cast the two groups on separate factors. Table 7 summarizes the key criteria with respect to the program evaluation question and the performance of the various rotation schemes with respect to these criteria.

Table 7: Rotation Techniques Compared on Key Criteria

Key Criteria	*4-factor varimax*	*4-factor theoretical*
Number of program planners on a shared factor	2 on A 2 on D	5 on A 1 on D
Number of consensus items	1	6
Total number of differentiating items	7	10
Number of significant sorts	17	17
Number of factors correlated above 0.3	2	0

The number of consensus items in the solution via theoretical rotation was much greater than with any of the varimax solutions and proved very beneficial despite several of them having factor scores close to each factor's neutral center; This was still seen as beneficial, because the consensus terms do not carry much salience for any factor. Low salience for the consensus items indicated where each factor was less contentious. Two such statements are as follows:

> *(+1, +2, +1, +2) If we want producers to value the use of production, reproduction, and genetic records, it is necessary to improve their income so they can pay for the technical assistance.*
>
> *(0, 0, -1, -1) What is the point of improving a cow's genetic potential if there are other problems later, such as nutrition, that really limit the impact of the improvement?*

Because the condition of instruction asked for placement of statements according to reasons for program *non-participation*, disputes are not over program goals or value. One of the most encouraging items discovered through theoretical rotation (and that varimax did not identify) was the consensus regarding a possible way to increase enrollment: through the local existing organizations, as seen in the following statement:

> *(+4, +2, +2, +3) If we want farmers to participate, the project must work with other organizations that are actually currently providing services to the farmers.*

This was interesting for two reasons. First, program planners at INML had already begun this process as of the 2002 calendar year. They had switched tactics in 2002 and began presenting program information through small, local organizations of about 10 farmers each. Experience, as well as the data, confirmed that this was a wise programming or marketing decision — and should continue. From a program improvement and evaluation perspective, this discovery was affirming. One program planner commented in the post-study follow-up interview:

> ***Researcher:*** *"Did any factors surprise you in this study, and, if so, which ones?"*
>
> ***Program Planner:*** *"Yes, one thing. Your summary said farmers think that INML needs to improve total efficiency and one part of that efficiency is the relation between institutions. I thought that as well – but I didn't expect this study to reveal that. I didn't expect it, but I believed it."*

In Uruguay several organizations operate on the local level, charge a fee, and are active in policy discussions. This situation makes these organizations political in nature and therefore suspicious of organizations that might attempt to attract members, particularly at the expense of local membership. The challenge for INML becomes how to work with local organizations to raise enrollment. Confirming this shared perspective – and its strength – was of particular value to program planners:

> ***Program Planner:*** *"This reality showed itself again, which is good. Sometimes it is not necessary to discover anything but it is necessary to*

confirm whether or not you are thinking correctly. I can now confirm that farmers think it is good for INML to be more efficient (effective) in their relationship with other institutions. Because I could sense this and it was revealed in the concourse, this implies this is a strong feeling among farmers."

The local organizations, then, become strategic leverage points for program intervention. Although there is no way for the current study to infer what percentage of non-participants are associated with each perspective, the critical point is that all of the perspectives are in agreement that working with the local organizations is a desirable way to increase participation in the genetic registry project.

Implications

The power of Q methodology to elucidate leverage points such as the one described above (working to increase participation through local organizations) holds implications for scientists and practitioners alike. The late Donella Meadows (1999, 3) described leverage points as "...places within a complex system where a slight shift in one thing can produce big changes in everything. We not only want to believe that there are leverage points, we want to know where they are and how to get our hands on them." In the study just described, theoretical rotation enabled researchers and program planners to locate where (through local organizations) and how (by working more cooperatively) to leverage increased participation in the Genetic Registry Project.

Among the community of Q scholars, there is no lack of fervor for the methodology itself. However, if the results of Q methodology research are to have practical value, research questions must be approached with an eye on intended use of the research outcomes, and these must be retained on the research "radar screen." As researchers embark upon analysis, specifically the rotation phase, the quality and applicability of outcomes need to take priority.

This is not a denunciation of varimax rotation. It *is*, however, an argument for *Q* researchers to be more attentive in their analysis to the theoretical and practical strategies pursued during the rotation phase, so that rotation proceeds with a specified purpose. Put another way: instead of taking for granted the procedural ease and statistical gratification from varimax rotation, the researcher employing *Q* might abduce *a priori* why answers are sought and what it might mean to get *certain kinds of answers*. Any rotation technique will produce answers, and, oftentimes, the answers are quite similar. But with Q factor analysis "the devil is in the details," and, although factor solutions may appear similar at first glance, what can be done with the answers may prove quite different in terms of understanding a phenomenon.

The Uruguayan example illustrated that the quality of the meaning derived from Q factors can be contingent upon the type of rotation scheme employed. This rotation decision may be particularly crucial to the improvement of social or educational interventions.

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Appendix

Q Sample and Factor Scores

No.	*Statement*	*Factor Scores*			
		A	*B*	*C*	*D*
1	If the price of milk were higher, I would participate in the genetic registration project.	-2	+1	-3	+1
2	The milk prices are too low, but we can't turn that around — we have to accept the current situation and see what we can do. It is not because of low milk prices that I have not participated.	+1	+1	+4	-4
3	If I had more time, I would like to participate in the project but the problem is that it takes time to sit at the computer and enter data in the computer.	+1	-4	0	0
4	All of my needs are covered so I don't see why I need to participate in the project.	0	-2	+2	+1
5	Farmers would participate in the project if it showed that by using the record and management system, they would improve their efficiency.	+2	+3	-3	+2
6	The project cannot solve the technical changes required to increase producer participation in the genetic record system.	0	0	0	-2
7	The way to get more producers to participate in the project is through the technicians that provide assistance.	+4	0	-4	-4
8	Producers simply do not want to use the record system - that's why they don't participate.	0	-4	0	-1
9	The Dairy Improvement Project has not worked enough with the technicians to train them in this technology so they can motivate the producers to use this tool.	+3	+3	0	-2
10	If we want producers to participate, the project must work with other organizations that are actually currently providing services to the producers.	+4	+2	+2	+3
11	If we want the producers to participate we have to help them to become more efficient as in other parts of the world.	+1	+4	-1	-1
12	In order for producers to utilize the system, the project needs to provide them with technical assistance.	+3	0	+1	0
13	I don't have the resources to participate in the project.	-3	-1	-2	0
14	I want to use the system of the Milk Improvement Project, but I need help to keep data and enter it in the computer.	+3	-2	-4	-3
15	I wish we could raise milk prices, but even if they were - I'm not sure that keeping records is worth it.	-1	-3	-2	-2
16	The reason I have not participated in the project is because the price of milk is very low - I don't have money to pay for the cost of the service.	-2	-1	-2	+1

No.	*Statement*	*Factor Scores*			
		A	*B*	*C*	*D*
17	I don't like to be pressured to participate. It is my decision and no one else's.	-1	+1	+4	+2
18	If we want producers to value the use of production, reproduction, and genetic records, it is necessary to improve their income so they can pay for the technical assistance.	+1	+2	+1	+2
19	Milk prices are low because the international markets and the policies of the bigger countries keep them low.	-4	+2	+3	0
20	What is the point of improving a cow's genetic potential if there are other problems later, such as nutrition, that really limit the impact of the improvement?	0	0	-1	-1
21	I don't see what the project can do to change the policies that determine the low prices of milk.	-1	0	+3	+4
22	The function of the project is important, but it should also focus on other, more relevant problems, such as nutrition.	0	+2	-1	-3
23	I already belong to a dairy organization and it is difficult for me to be part of several different ones.	-2	-3	0	+2
24	The genetic registry project has a very specific task; it cannot be dedicated to solve all the producer's problems so that they will participate.	0	-1	+1	+1
25	The only way for producers to participate more in the project is through the improvement of the entire technological process of the industry chain, so that the producers can become more competitive.	-2	+3	-1	0
26	If we could modify the international markets, milk prices would be more favorable to us.	-4	+4	+2	+4
27	The project has not had many members because it has worked in an isolated way, separate from other local organizations.	+2	-2	0	-2
28	I don't know about the services that the dairy improvement project can provide me.	+2	+1	+1	-1
29	More producers would be using the record system if they were trained to collect and enter data in the computer.	+2	0	-3	+3
30	I am loyal to my organization that I work with; it provides all of the services I need.	-1	-2	+2	0
31	I don't see what the project can do to help increase low milk prices.	-3	-1	+3	-3
32	I don't believe milk prices are likely to increase, so I don't think I will participate to keep records.	-3	-3	-2	+3