Eight Quantum Realities Redux: Finding David Bohm*

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Abstract: *This paper addresses a basic component of Q methodology, namely, how judgmental rotation of centroid factors empowers the researcher to more thoroughly investigate communicability. A Q study of eight interpretations of quantum facts, genuinely worldviews in themselves, is the vehicle for the exposition, and two rotations, both theoretical, are examined. The first rotation is an exercise in intellectual curiosity (intellectual play) that was carried out in 2001; the second ensued from work published by Simon Watts and Paul Stenner in 2003 and from comments and responses to them by Steven Brown.*

Introduction

The line of thought leading up to the present paper began as a conversation with Simon Watts at the 18th Q conference at Durham University in 2002. We had presented papers, one after the other, on a sunny fall afternoon at the campus where Stephenson took his first doctorate, and I remember clapping my hands spontaneously during Simon's talk. The issues he raised that day are not to be stated easily even yet; it is an aim of this paper to shed a little light on them through a demonstration of how a bud from an abductory moment can blossom into full flower.

That day at Durham I think I was one of the few, if not the only one, to applaud with enthusiasm. Simon had upset the assembled friends of Q when he suggested a new way to think about communicability and quantum theory. One could hear a gasp or two, as I remember it, when he proceeded to pronounce a hitherto unvoiced rejection of the Copenhagen Interpretation of quantum facts in favor of another interpretation which had been put forth by the American physicist David Bohm. (Rex Stainton-Rogers, who had been Stenner's doctoral professor and who had passed away in 1999, would have loved that moment! Rex was such a rascal and liked nothing better than

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* I wish to thank Steven Brown and the reviewers of this paper for thoughtful and useful suggestions. An earlier version was read at the 21st ISSSS Q Conference, Simon Fraser University, Vancouver

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Operant Subjectivity, 2005 (April), 28 (3): 145-166

stirring the pot for no reason beyond wanting to see what would happen next.) After Simon had finished and the session broke for tea, a very good friend of Q stopped me in the hallway and asked why I had clapped. I replied that I couldn't exactly explain why but that I always welcome discoverers. Now, to me that moment was subjectivity in a very raw form: while Simon was speaking I had had a flashing glimpse: he was daring to offer up an interpretation of communicated behavior that is truly of a different kind, one that proceeded from a foundation level. In Q we know such a glimpse as an abduction.

Until that day, the Q community had talked almost exclusively about the Copenhagen Interpretation, although Stephenson had written that quantum theory of the mind had evolved from Spearman's principles of cognition and that "The new probabilistic stemmed from psychology, not by analogy from physics" (Stephenson, 1990: 118). Yet it seemed to me that Simon was on the trail of something interesting and maybe important, whatever it might be and where ever it might lead. I want to show in the present paper that his argument is at the same level of abstraction as the physicists' interpretations of quantum facts.

Performing a Theoretical Q Study as Intellectual Play

He and I exchanged e-mails for some months, but I had to lay aside for a while for personal reasons my interests in his project. At some point later, though, as I was again thinking about his ideas, I recalled a presentation I had made at the 17th Q conference at Ball State University in 2001 entitled "A Q Study of Eight Quantum Realities." At that time I had been reading the non-technical literature on quantum theory and had been surprised to learn that while quantum facts were generally undisputed by physicists and by philosophers, there was great ferment amongst these very same people about what the facts mean.[†] This controversy continues, so to satisfy my curiosity, I had decided to conduct a little experiment, the Q version of a so-called "thought experiment," in the form of a completely theoretical Q study, based mainly upon physicist Nick Herbert's book *Quantum Reality* (Herbert, 1985). I assembled a concourse from him, plus ideas from Alistair Rae, Ilya Prigogine, Richard Feynman, John Gribbin and others who have written about the meaning of quantum facts. Herbert's own interpretation of eight quantum realities offered a starting point for a simple factorial design, shown here as Table 1.

[†] "If world views really are cultural products, as Pickering and Kuhn argue, then it should be no surprise that there are different interpretations of quantum reality." John Gribbin, British physicist and writer, continues, "How we interpret that mathematical description of reality is in large measure (perhaps entirely) a matter of choice." (Gribbin, 1995: 199)

Table 1: Factorial Design

Effects	***Measurement Issues***	***Interpretation Issues***
Items	Positive (+) (2 x 8 = 16)	Negative (–) (2 x 8 = 16)

Thusly, a Q sample of 32 items was selected from the concourse, and I performed a Q sort to represent each of the eight interpretations as put forth by Herbert. These were duly factored, using PCQ for Windows, yielding seven centroid factors. A judgmental rotation was then performed with these questions in mind: 1) Can the Copenhagen Interpretation be identified? 2) If so, how will the other positions be related to it? and 3) Can all of the sorts be accounted for? Results of that rotation are shown in Table 2.

Table 2: Rotated Centroid Factor Structure Reported in 2001

Eight Quantum Interpretations	***A***	***B***	***C***
1. Universe Has No Deep Reality (Bohr)	86*	10	30
2. Observation Creates Reality (Wheeler)	79*	04	25
3. Universe Is An Undivided Wholeness with Hidden Variables (Early Bohm)	-06	28	21
4. Universe Has Many Worlds (Everett)	-18	62*	-21
5. New Kind Of Human Logic Required (Early Von Neumann)	08	-33	83*
6. Universe Is Made Of Ordinary Objects (Later Bohm)	-07	52*	-25
7. Consciousness Creates The Universe (Later Von Neumann)	28	-37	80*
8. Universe Is Unrealized Potentia (Heisenberg)	65*	-41	-14

* denotes a loading as significant at .46. Decimals omitted.

Table 2 shows seven of the eight sorts with significant loadings associated with three factors. Note that the Copenhagen Interpretation is represented as Factor A (Bohr, Wheeler and Heisenberg), that efforts to connect quantum theory with classical physics are represented by Factor B (Everett and the Later Bohm), and that efforts to maintain a special role for humanity are represented by Factor C (the Early and the Later Von Neumann). Neils Bohr, John Wheeler and Werner Heisenberg accept, according to quantum facts, a universe that has no objective reality until a measurement is made and that until then reality hovers in uncertainties and superpositions. This is the Copenhagen Interpretation, also called the Standard Interpretation. The Many Worlds point of view put forth by Hugh Everett joins with David Bohm's idea that the Universe Is Made Of Ordinary Objects to form Factor B; these points of view would appeal to physicists because of the claims that since there are no measurements of reality, only correlations with reality, and since all is ordinary anyway, reality must be ordinary, too. On Factor C, John Von Neumann's long struggle to formalize quantum facts in human terms appears in a reasonable fashion.

In 2001 I had felt pretty good about this solution. But, please note that the characterization of the universe as an Undivided Wholeness with Hidden Variables, namely Q sort 3 (Early Bohm), did not load on any factor nor did it define a factor on its own. Actually, in Herbert's book, Bohm's evolving thought has influenced three of the eight interpretations: Bohm's 1951 text book has been called one of the most accessible accounts to date of the Copenhagen Interpretation; yet, he later came to defend vigorously the existence of hidden variables. He has most recently put forth the idea that humanity does not merit a special position in the universe because the universe is made entirely of ordinary objects. (Gribbin, 1990: 50) In 2001, however, I had satisfied myself that the disappearance of Bohm's conjecture of Undivided Wholeness with Hidden Variables had resulted from, to my way of thinking then, a seemingly restless movement on his part from one interpretation to another. I had been mistaken: Bohm was a discoverer and not at all capricious. Please bear with me a little while, for after showing the results of the 2005 factor solution I will expand upon these ideas and try to connect them with Q methodology. Please notice that such a connection as this one can be stated only after an abductory moment, if I could find David Bohm I would also find Watts and Stenner!

Eight Quantum Realities Redux

As I have thought these matters through again, and read a lot more, especially the works done by Rex and Wendy Stainton-Rogers and their students, it appeared to me that Simon and his colleague (and doctoral advisor) Paul Stenner had taken seriously Bohm's idea of a universe that is an undivided wholeness with hidden variables.[‡] So armed, I returned to the unrotated centroids from the 2001 Q study and looked again, this time to pay special attention to David Bohm. Using judgmental, i.e., theoretical, rotation, I wondered if another solution would be possible and what might the results be? First, though, the seven unrotated centroids are shown in Table 3.

There is much information in Table 3 that provides clues for the alert researcher. Examining the table of raw loadings can be of great use before any rotation is performed. A glance at the first column, Factor 1, indicates

[‡] As it turned out, I was mistaken. Watts later told me that they had not considered this specific idea while writing the paper.

that the communicability under study is entangled. Seven of the eight sorts having high loadings, but, notably, two of them have high negative loadings. (The phrase "high loading" in this context means near or above the level of significance, which is .46 for a Q sample of 32 items.) Additionally, two of these sorts have high loadings on both Factors 1 and 2, and thus are confounded. Q sort 8, Universe Is Unrealized Potentia, has high loadings on Factors 1 and 3. Also, Q sort 3, Universe Is Made of Undivided Wholeness with Hidden Variables, has only moderate loadings on factors 1 and 3. Additionally, please note that each sort's communality is recorded in the rightmost column, labeled h^2. Communality is a measure of a sort's relationship with all factors, expressed as a percentage. Please note that communalities for six of the sorts are very high; however, the communalities for the two Bohm interpretations, sorts 3 and 6, are low by comparison. All of this information tells us that rotation is required and furthermore suggests ways to proceed based upon the facts as laid out via the factor analysis. The unknown was this: would my abductory moment at Durham bear fruit through a rigorous scientific test?

Table 3: Unrotated Centroid Factors

	Unrotated Centroid Factors							
Eight Quantum Interpretations	***1***	***2***	***3***	***4***	***5***	***6***	***7***	h^2
1. Universe Has No Deep Reality (Bohr)	63*	57*	25	22	15	03	-13	85
2. Observation Creates Reality (Wheeler)	56*	50*	27	14	12	-17	19	72
3. Undivided Wholeness With Hidden Variables (Early Bohm)	-35	13	27	-16	11	-08	08	26
4. Universe Has Many Worlds (Everett)	-67*	16	14	-08	03	17	-01	52
5. New Kind of Human Logic Required (Early Von Neumann)	63*	-43	38	22	-17	-09	-08	80
6. Universe Is Made Of Ordinary Objects (Later Bohm)	-68*	26	16	-14	05	-08	-30	67
7. Consciousness Creates The Universe (Later Von Neumann)	80*	-23	39	10	-14	11	00	89
8. Universe Is Unrealized Potentia (Heisenberg)	59*	25	-41	29	29	18	07	78

* Denotes a loading as significant at .46. Decimals omitted

The rotation strategy that was followed had the following propositions in mind: 1) Can Bohm's positions, namely, sorts 3 and 6, identify a factor? but, 2) Can it be accomplished without spoiling either the Copenhagen or the Von Neumann interpretations? and 3) Can all the sorts be accounted for? The results are shown in Table 4.

Table 4: 2001 and 2005 Factor Structures After Rotation

	2001 Rotated Centroids			2005 Rotated Centroids	
Eight Quantum Interpretations of Reality	***A***	***B***	***C***	***A'***	***B'***
1. Universe Has No Deep Reality (Bohr)	86*	10	30	77*	-07
2. Observation Creates Reality (Wheeler)	79*	04	25	56*	02
3. Undivided Wholeness with Hidden Variables (Early Bohm)	-06	28	21	-13	47*
4. Universe Has Many Worlds (Everett)	-18	62*	-21	-22	56*
5. New Kind of Human Logic Required (Early Von Neumann)	08	-33	83*	-08	-54*
6. Universe Is Made of Ordinary Objects (Later Bohm)	-07	52*	-25	-05	58*
7. Consciousness Creates the Universe (Later Von Neumann)	28	-37	80*	08	-56*
8. Universe Is Unrealized Potentia (Heisenberg)	65*	-41	-14	63*	-34

* Denotes a loading as significant at .46. Decimals omitted

In Table 4, columns A, B, and C contain the 2001 loadings after rotation, repeated from Table 2; the columns labeled A' and B', (that is to say A-prime and B-prime) contain the 2005 rotated loadings. Again, there is a great deal of information summarized in this table.

Notice now the 2005 factor solution, in the columns designated as A' and B'. The Copenhagen Interpretation is retained intact as Factor A', with very little change in the loadings from 2001. Factor A' emphasizes that the universe has no deep reality, and that until a measurement is taken there exist only the uncertainties and superpositions of physical possibilities. Factor B', however, has been changed in a fundamental way and is now bipolar. On the 2005 rotation, Everett's Many Worlds conjecture joins David Bohm's two interpretations to make up one pole of Factor B, although one of the sorts has a somewhat low loading. The viewpoint of this pole emphasizes the disconnectedness of the universe in terms of Many Worlds, the Undivided Wholeness, and the ordinariness of the universe's contents. Von Neumann's two attempts to place human endeavors at the center of quantum reality with a new kind of logic and a reliance on the concept that consciousness creates reality, which had defined Factor C from 2001, has been repositioned at the opposite pole of Factor B'.

To fully account for these changes and for their implications, one must be prepared to make a detailed analysis of the 2005 rotation, which I will turn to now.

Some Reasons Why Judgmental Rotation Is Important

This is a good place to discuss issues involved with judgmental rotation. Twelve rotations were required to achieve the loadings shown in Table 4. (Please see the Appendix for a detailed listing of the 2005 Q study results, including a table of the varimax rotation factor loadings.). As noted in the previous paragraph, the 2005 factor structure is quite different from that of 2001. One must ask at this point why did this happen? Or, was this 2005 rotation merely a fabrication, some variety of post-hoc rationalization, on my part? The critics of judgmental rotation point to its non-objective nature, saying that the views, predispositions and goals of the researcher will produce solutions that should be taken as little more than self-justification and therefore must be guarded against. The most extreme form of this criticism originated among those positivists who have ignored Q anyway. I reject their characterization in its entirety, of course, because it is founded upon a false presumption that a mathematical rotation is the only way of science. To my way of thinking, nothing could be farther from best scientific practice. Yet some friends of Q, as I like to refer to participants in our community, are also sometimes uneasy with judgmental rotation due to what is thought to be the indeterminacy of the exercise: in mathematical terms alone, since there are an infinite number of ways to rotate the sorts, any one rotation is as good as any other one. Stephenson gives us some guidance, in the *Study of Behavior*, for the situation facing us:

> That confusion abounds in factor analysis is almost self-evident... That a dark impenetrability exists is only too true...Thurstone rotates, but Burt does not do so, for precisely the same centroid factors... It may well seem that little can be trusted, much less understood, about factor analysis (Stephenson, 1953: 33).

And, on the previous page, he points the researcher to another important fact about rotating centroid factors:

> [I]t consists, in practice, in solving the centroid factors, by rotations, so as to provide answers for propositions which have been asserted beforehand or which are 'held' theoretically (Stephenson, 1953: 32).

A little later he says,

> The centroid factor method leaves open for us innumerable possible solutions, and the concreteness of inferential interbehavior contemplates, no less, innumerable possibilities in the pursuit of scientific investigations... It consists of rotating centroid factors to reach predicated effects, if the data can

provide them, by using every applicable 'cue,' 'hunch,' or 'trick of the trade' to guide us. The investigator puts his questions to the data as testable propositions" (Stephenson, 1953: 39).

Now, at first reading of the above, one's concerns can hardly be pacified. But upon a little reflection the meaning and importance of what Stephenson is saying become clearer: He draws our attention to the indeterminacy built into centroid factor analysis and judgmental rotation as key advantages! He is saying that this indeterminacy puts the researcher's motives at the forefront of all else in Q methodology, where they belong, and that this is a good thing. In more common language, Stephenson is telling us we must always answer two questions before we conduct a judgmental rotation. 1) What do we want to know? 2) What are the rules and procedures by which we will find out what we want to know? More specifically: for unstructured samples, seeking the orthogonal structure that best fits the data; for structured samples, rotating in terms of theory built into the balanced design of the statements and selection of sorters for theoretical purposes (Stephenson, 1953: 41).

How does this work out in practice? Recall that the interrelationships of the sorts are fixed by the sorters themselves whenever they complete their sorts. One way to think about this process is to imagine each completed sort as a lineup of the ranked items. In the present paper's 2005 Q study, therefore, we begin with eight lineups, which are called, more formally, vectors. These vectors share several characteristics, namely, each has the same length, each has the same mid-point, i.e., the same zero; they share the same data space and can be analyzed accordingly. Centroid factor analysis begins with the correlating of these vectors and proceeds to ascertain the mathematical relationships amongst those correlations with great precision. Stephenson referred to the resulting raw factors as pure numbers, i.e., dimensionless numbers, because they are interrelated only to themselves (Stephenson, 1990). Centroid factor analysis, therefore, answers the questions: How do these vectors, or lineups, compare with each other? Can the eight of them be accounted for in fewer dimensions, and if so, in how many? What are the mathematical relationships between these resulting dimensions? The answers to these questions are the loadings displayed in Table 3, the unrotated factor matrix.

But, please notice that centroid factor analysis cannot answer another question vital to us: Where is the center, i.e., the zero or the origin, in the data space of this factorial structure? It is here that factor rotation comes on stage because it is the function of rotation to designate the origin, i.e., a frame of reference for the centroids.[§] And it is here the investigator must put

[§] Think of the surface of a balloon. All points on that surface serve equally well as the origin. We project the factor loadings on that surface and turn the balloon to suit our theoretical purposes. On this picture, it is easier to see that the relationships between the sorts cannot change as we rotate this way or that.

forth propositions, in the form of testable questions, to test with a judgmental rotation.

I invite you now to recall that before doing the rotations in 2001 and in 2005 I stated what I wanted to know like this.

- In 2001 the questions were: 1) Can the Copenhagen Interpretation be identified? 2) If so, how will the other Q sorts be interrelated with it? and 3) Can all of the sorts be accounted for.
- In 2005: 1) Can Bohm's positions, namely, sorts 3 and 6, identify a factor? but, 2) Can it be accomplished without spoiling either the Copenhagen or the Von Neumann interpretations?; and 3) Can all the sorts be accounted for?

Now, significantly, it must be remembered that the rules and procedures in judgmental rotation are such that either or both of these rotations would have failed if the interrelationships uncovered in the factor analysis would not allow it. How can it be that the questions might fail the test of rotation? The short answer is, because the interrelations between the sorts, i.e., the positions between them in data space, are not changed in any way by rotating. Since relationships between the sorts can not be distorted or falsified in rotation, one is forced to accept the fact that sometimes sorts will come together and sometimes they will not.

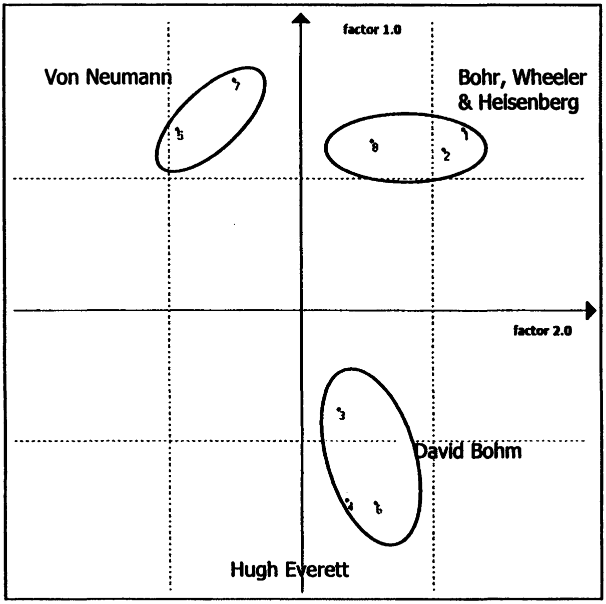
Visualizing the Judgmental Rotation

Visualizing relationships between the sorts helps one see what is and what is not possible to accomplish in judgmental rotation. To illustrate how this works, I invite you to take a look at the positions of the eight sorts as revealed by plotting unrotated factors 1 x 2 in Figure 1; two more useful plots of unrotated factors 1 x 3 and 2 x 3 follow. [NB: To obtain a complete picture of the unrotated factor structure would require $\frac{1}{2}\,r\,(r-1)$ plots, where r is the number of factors. Thus to show the structure of all seven in this example would require ½ 7 (7 - 1) = ½ (42) = 21 plots.]

Because some may have never before seen two factors plotted, please allow me to offer a little background information before continuing.

Before a judgmental rotation, it is my custom to examine the unrotated factor matrix, as was described earlier, to look for clues, and then to browse plots of them, again looking for clues. I think these activities are technique aspects of what Stephenson referred to as "applicable cues, hunches and tricks of the trade." (Stephenson, 1953: 31) There are other aspects; my practice is to make a list of the Q sorts to use for reference purposes as the rotations proceed and to make a note of the objective of each rotation. In the figures that follow, on each plot I have labeled the sorts and also visually identifiable groupings of sorts to help keep straight who is who and who is where. These are two tricks of the trade. For example, in Figure 1, one can visually identify three groupings. I have circled and labeled them.

Figure 1: Plot of Unrotated Factors 1.0 X 2.0

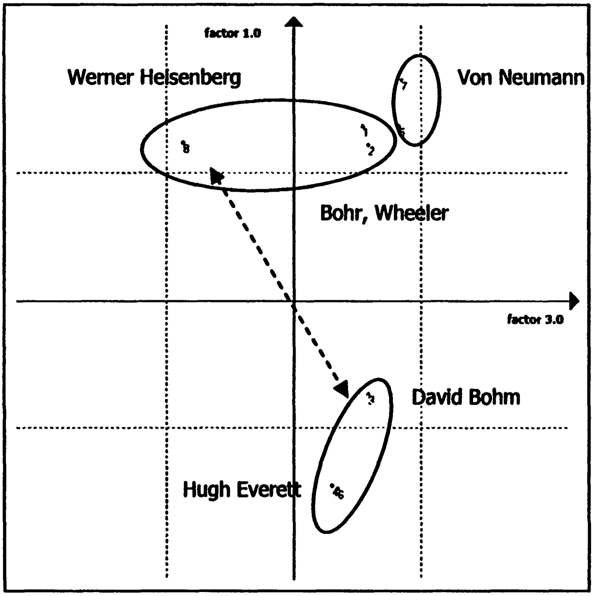


Note that the two axes in Figure 1, labeled Factor 1.0 and Factor 2.0, are fixed at a 90-degree angle but can be rotated freely. The point where they intersect, the origin, does not move at all. Thus, no matter how one might turn the axes, sort 3 will never move away from the center. This means that rotation of the axes will have little effect on sort 3. On the other hand, the other seven sorts will be effected to greater extents. The plot suggests three factors, one perhaps bi-polar.

The dotted lines are set at .46, meaning a sort outside them has a significant loading.

Even at this beginning point, the advantage of visualizing relationships, in the data space, is striking. The plot in Figure 1 suggests three groupings, each of them moderately tight and well within our previous expectations. So far, so good, but we will need to browse two more plots before we know enough to perform the first trial rotation.

Figure 2: Plot of Unrotated Factors 1.0 X 3.0



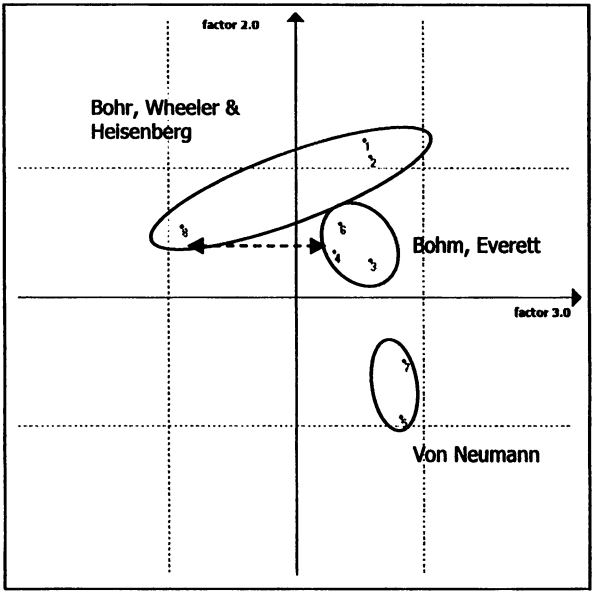
Plotting Factors 1 and 3 (Figure 2) shows how Von Neumann, sorts 5 and 7, are very close to sorts 1 and 2, parts of the Copenhagen Interpretation.

Additionally, note that the Heisenberg representation, sort 8, is far away from its partners and is almost bi-polar to the grouping of sorts 3 and 6, Bohm, and sort 4, Everett. This relationship has been flagged with a dotted line.

Viewing the plot of Factors 2 x 3 in Figure 3 reinforces the concerns suggested at Figure 2. Considering the two plots together, delicacy will be required to avoid confounding the Heisenberg sort on more than one factor. Indeed, the varimax rotation of these factors resulted in confounding the Heisenberg sort between two factors.

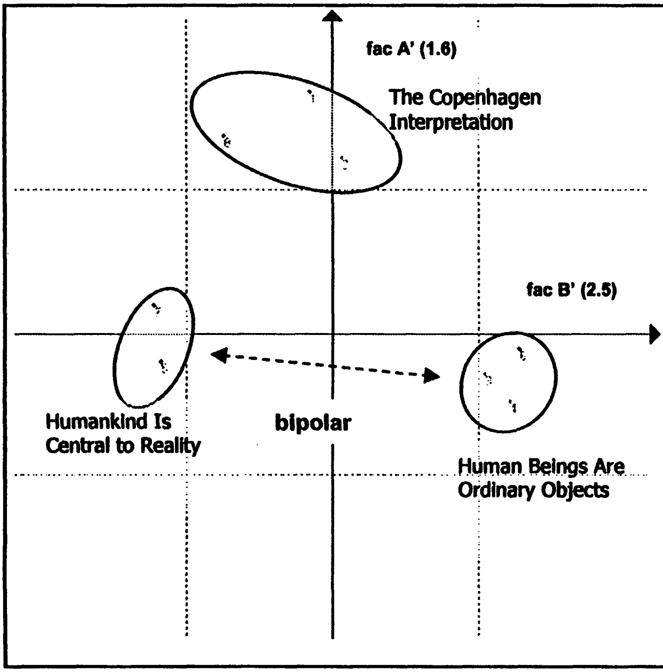
Due to space constraints, I will not here continue through the eleven trial rotations; each is listed in the Appendix. However, to re-iterate, I had these testable propositions: 1) Can Bohm's positions, sorts 3 and 6, identify a factor? 2) Can it be accomplished without spoiling the Copenhagen or the Von Neumann interpretations? and 3) Can all sorts be accounted for?

Figure 3: Factors 2.0 X 3.0 Before Rotation



To achieve the 2005 solution, I rotated toward the two sorts representing Bohm's ideas, i.e., I sought to shift the variance spread across the seven factors in such a way that Bohm's two sorts would reach significance. In the rotation process I found that the Bohm sorts and the Everett sort converged; this was not surprising since it is well known that Bohm subscribed to some aspects of the Many Worlds interpretation. Nor was it surprising that the two Von Neumann sorts came together. A surprise for me appeared in the difficulty I had with the Heisenberg sort; it took some care to avoid confounding it on Factors A' and B'. This success, though, led to another surprise: the bipolar factor B'. I have labeled each end: Human Beings Are Ordinary Objects (Bohm & Everett) and Humankind Is Central to Reality (Von Neumann). Figure 4 shows the final factor structure.

Figure 4: Factors A' X B' After Rotation



Note: Factor arrays for A' and B' correlate -.40.

By convention, from this point forward, factors are designated by letters instead of numbers. Thus Factor 1.6 is now labeled Factor A' and Factor 2.5 is now labeled Factor B'. Additionally, the sorts comprising each factor are now labeled descriptively rather than by a person's name.

Figure 4 shows that sorts 1, 2 and 8 have significant loadings on Factor A'. Sorts 3, 4 and 6 have significant loadings on Factor B'. Importantly, sorts 5 and 7 are shown to be in bipolar relation to them. One should report each end of a bipolar factor separately even though the negative end is merely the reflection of the positive end. (Brown, 1980: 253)

Quantum Realities Redux

After all the technical material, if you are still with me, you might ask, "So, what is this fuss over quantum realities all about?" And, logically, you might also ask, "What does any of this have to do with Q?" The fuss, at a very abstract level, is about the nature of everything and about what place, if any, humanity has in it. The physicists cited in this paper in a seemingly casual manner, plus others not mentioned (including Einstein!), are very serious thinkers. In common, they believe that quantum mechanics, i.e., the practical and factual basis upon which quantum interpretations rest, even if very strange, is so fundamental that they have applied their skills and insights to pursue the ancient problems of understanding nature and of humankind's place. Interestingly, there really aren't that many physicists who have taken up this pursuit, at least not in the strictest sense. All the non-technical books on quantum theory say in one way or another that the people who use the equations of quantum mechanics, the scientists and engineers, never ask such questions. They do not have to because the answers quantum mechanics provide are exquisitely precise for their purposes. Surely such confidence is a blessing for them. Yet, for a few, having the right answer has not been good enough, not satisfactory. Bohr and Einstein, for example, debated over the validity of quantum theory for half of their lives! Meanwhile, their followers invented, discovered, expanded, refined quantum theory until today. Along the way Einstein made up thought experiments, trying at first to disprove quantum theory and, failing in that, trying later to limit its generalizability. His most famous attempt came in 1935. Every physics student must know it, and know that it disturbed the physics community for forty-eight years! It is known as the Einstein-Podolsky-Rosen Paradox, which attempted to demonstrate the existence of extra components of reality not included in quantum theory, thereby proving that it was incomplete. About thirty years or so later, an Irish physicist named John Bell devised a way to test the E-P-R Paradox. It is called the Bell Inequality and it is based upon ideas first put forth by David Bohm in the 1950s. Bell showed, through a formal proof, that "no local model of reality can explain the results of a particular experiment," to use Nick Herbert's version of it. "In short, reality is non-local." But not until the mid-1980s did the Aspect experiments demonstrate directly that the quantum world does not obey the same laws of common sense that we experience every moment (Gribbin, 1998: 22-23). The results of the Aspect experiments, which endorsed Bell, drew flocks of physicists back to Bohm's Hidden Variables concepts after they had lain unused for almost thirty years. It had taken a half century to accomplish this, and by doing so it had shown Einstein to have been wrong about quantum theory.

The point I am trying to make here is this: Even with an interpretation that is consistent with quantum facts, sometimes decades pass before anything useful comes from it. And, a corollary of this is that even when an interpretation is consistent with quantum facts it can prove to be wrong**, as was the case with Von Neumann's Humankind As Central to Reality, revealed in the 2005 rotation to be in bipolar relationship to Human Beings Are Ordinary Objects. Meanwhile, the Copenhagen Interpretation, even with

** Amazingly, it took almost twenty years before it was appreciated that Von Nuemann's logic contained an elementary error.

such strange components as superpositions and so-called "spooky action at a distance,"continues to be the standard interpretation. And, a revival of Bohm's interpretation has not devalued it in the least; instead the E-P-R cum Bell cum Aspect episodes have fortified it. Questions about the nature of the universe with humanity in it are even more open for discovery. All this is borne out in the 2005 Q study at Factor B', in glorious bipolar fashion.

And Q Methodology Realities

And now you ask, "So what does all that have to do with Q?" I have used many paragraphs to this point to set up the response to this question properly. I can not pretend to understand most of the mathematics of quantum theory, but with the little Q study reported here I have gained insights into physicists' motivations and, by implication, into some of their worries. The factor solution obtained in 2005 offers insight into Q methodology and communicability, too. And, for another thing, one can hardly ignore the simple pleasure of viewing patterns of Q sorts on a simple plot of factors X x Y! To appreciate them one need not know a thing about a table of numbers, nor how they got there. This is a beautiful aspect of our methodology, and it holds out valuable promise as an aid in our investigations. Here, then, in three parts, is a more specific reply to the question, and I offer it is as the big idea in this paper:

1. If numerical results of factor analysis are genuinely at the same level of abstraction as quantum facts, then interpretations in and about Q, including judgmental rotation, are at the same level as the interpretations of quantum reality and the community should go forward accordingly.

The reasoning, of course, is not new at all but is as old as the methodology. When Stephenson, in a letter to *Nature* published in the summer of 1935, had announced the birth of Q Methodology he had put forth his (disturbingly simple) interpretation of factorial facts. It is not ironic, however, to note that just about a month or so earlier, Einstein and his two colleagues had published the E-P-R Paradox. For almost all the time since then the Q community has concerned itself with differentiating, from all the other factorists, its theories, rules, and standards of procedure. Throughout we have claimed a special way of knowing and studying communicability as serious thinkers. The results of the 2001 and 2005 rotations reported here demonstrate this in a rigorous way, that the Q community can defend the claim that Q methodology works at the same level as quantum theory. I think, as has been argued by several in our community, that factor analysis is the *quantum mechanics of communicability*. I think that if this is so and that if quantum facts are on the same level as *factored q sorts facts* we can claim that the eight quantum realities are on the same level as the *communicability reality* set forth and invigorated by Simon Watts and Paul Stenner, and another *communicability reality* so eloquently elaborated by Russ Hurd and Steven Brown.[††] We, too, are serious about the nature of communicability. Parts 2 and 3 follow from this.

2. Factor A' from the 2005 rotation sustains Q's way of addressing the indeterminacies of communicability and subjectivity. But one must bear in mind that the Copenhagen Interpretation emphasizes action at a price of certainty, and furthermore that the result of a quantum measurement of action is itself a probability and not determinant. Similarly in Q, until a sort is performed, any reality of communicability hovers in uncertainty, and the factor structures we can obtain are probabilistic models only. Those seeking a Holy Grail of truth will find no solace in Factor A'. They will, however find tolerance and a space to grow. Or, to paraphrase a friend of Q's way of putting this, centroid factor analysis and judgmental rotation work together to form an abductory method of science wherein one can find plausible explanations that account for unexpected, intriguing, puzzling, indeterminate facts.

3. The bipolarity of Factor B' illuminates the extraordinary tension associated with questioning the nature of nature and of humankind's place. Yet the poles of Factor B' are not to be accepted as a simplistic duality. Rather, one is inspired to recognize them as a dialectic requiring a balancing of careful reflection and forceful argumentation because both are plausible explanations of an ancient and intriguing puzzle. Watts and Stenner have invited us to explore Q factors in this spirit, to utilize the tools of the discursive turn in experiments at various levels of the evident difficulties of communicability.

So now I have my answer for my friend at tea time: I applauded not in surprise but in celebration of an abductory moment, provided by Simon Watts, that has lead me on an intellectual adventure that I might not have taken otherwise. The sobering side, though, is that we have so much more to do: What might "non-locality" imply, in terms of communicability and subjectivity? What about Feynman's path integrals, Cramer's transactional interpretation? And, perhaps most important, how am I to respond to my grandchild's question, "Grandpa, what is communication all about?" Just as the physicists, I have no single, unifying metaphor. Perhaps I will rely upon John Gribbin's (1998: 240) advice: "But nobody knows what the quantum world 'is'; all we can know is what it is 'like'. Sometimes it is like one model, and sometimes it is like another model. And that's reality." We have

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[††] For an inspiring exchange of ideas stimulated by an article written by Simon Watts and Paul Stenner, please see the theme edition of Operant Subjectivity entitled "Q Methodology, Quantum Theory and Psychology" (July 2003 Vol. 26 No. 4). For further enlightenment, I suggest a close reading of Russ Hurd's and Steven Brown's Q Study on the Future of the Q Movement, which untangles some of the communication complexities existant in the Q community.

now, positively and successfully, divided issues facing our community into two distinct but entwined columns: measurement and interpretation; interpretation and measurement. This is healthy. This is alive, robust, and pregnant with discovery.

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Appendix: Edited Log of PCQ Study File

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Eight Views of Quantum Reality
Based upon 8QR_for 9.sty

Unrotated Factor loadings                        8QR_for 9.sty
Sort         1    2    3    4    5    6    7    8

Factor   1  63   56  -35  -67   63  -68   80   59
Factor   2  57   50   13   16  -43   26  -23   25
Factor   3  25   27   27   14   38   16   39  -41
Factor   4  22   14  -16   -8   22  -14   10   31
Factor   5  15   12   11    3  -17    5  -14   29
Factor   6   3  -17   -8   17   -9   -8   11   18
Factor   7 -13   19    8   -1   -8  -30    0    7
-----------------------------------------------------------------
Note: Leading decimals have been omitted.

Varimax Rotation                                 8QR_for 9.sty
=================================================================
                                      Factors
Sort  Label                  1     2    3    4     5    6    7   h2
1  QR1 Copenhagen 1         20   89* -17   -7     4    4  -10   89
2  QR2 Copenhagen 2         18   81*  -3    6    -1  -11   18   75
3  QR3 Und. Wholeness      -18    1   49*   0     6    1    2   28
4  QR4 Many Worlds         -42  -17   46*   0     0   31  -11   53
5  QR5 Non-human Logic      88*   9  -14   10     0   -7    0   83
6  QR6 Neorealism          -44   -8   54*   0    -2    8  -41   68
7  QR7 Consc. Creates       85*  29  -20  -14    -1    3   13   89
8  QR8 Heisenberg Real'ty -5     46* -72*   0    23    2   14   81
-----------------------------------------------------------------
* Denotes a loading significant at 46
```

Factors	1	2	3	4	5	6	7	Totals
eigens	2.01	1.81	1.37	0.04	0.06	0.13	0.28	5.69
% variance	25	23	17	0	1	2	3	71

Graphical Rotation 8QR_for 9.sty

Sort	Label	1	2	3	4	Factors 5	6	7	h2
1	QR1 Copenhagen 1	77*	-7	26	26	10	34	8	86
2	QR2 Copenhagen 2	56*	2	28	26	7	29	40	72
3	QR3 Und. Wholeness	-13	47*	14	-7	-2	4	-1	27
4	QR4 Many Worlds	-22	56*	-11	-8	-23	2	-29	53
5	QR5 Non-human Logic	-8	-54*	41	36	40	17	4	81
6	QR6 Neorealism	-5	58*	14	-14	-28	-19	-40	67
7	QR7 Consc. Creates	8	-56*	36	25	42	44	11	91
8	QR8 Heisenberg Real'ty	63*	-34	-41	17	14	5	23	79

* Denotes a loading significant at 46

Factors	1	2	3	4	5	6	7	Totals
eigens	1.39	1.62	0.69	0.40	0.53	0.47	0.49	5.59
% variance	17	20	9	5	7	6	6	70

Graphical Rotation 8QR_for 9.sty history

Num.	Factors		Degree
001	2.1	5.1	23
002	2.2	7.1	9
003	1.1	7.2	-21
004	6.1	7.3	29
005	2.3	4.1	7
006	2.4	3.1	-15
007	3.2	6.2	-41
008	3.3	5.2	-27
009	6.3	5.3	-26
010	4.2	7.4	13
011	1.2	2.5	4

Factor A for 8QR_for 9.sty (Graphical) 8QR_for 9.sty

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

Sort with significant loadings:

label	sort	load	label	sort	load
QR1 Copenhagen 1	1	0.77	QR2 Copenhagen 2	2	0.56
QR8 Heisenberg R'ty	8	0.63			

Factor B for 8QR_for 9.sty (Graphical) 8QR_for 9.sty

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

Sort with significant loadings:

label	sort	load	label	sort	load
QR3 Und. Wholeness	3	0.48	QR4 Many Worlds	4	0.56
QR5 Non-human Logic	5	-0.54	QR6 Neorealism	6	0.59
QR7 Consc. Creates	7	-0.56			

Factor correlations (Graphical) 8QR_for 9.sty 0

Factors	A	B
A	0	-40
B	-40	0
reliabilities	92	95
std. errors	43	34

Item scores (Graphical) 8QR_for 9.sty

	Factors	A	B
1.	Attributes do not belong to the quantum entity itself but reside in the "entire measurement situation." QR1	2	0
2.	Quantum uncertainty is more than just an irreducible fuzziness existing "out there." QR1	3	-3
3.	A quantum entity's so-called attributes are really relations between the entity and its measuring device and do not properly belong to either. QR1	2	0
4.	Our choice of what we will precisely measure makes conjugate attributes maximally uncertain. QR1	2	-1
5.	The past is not fixed but alters according to present decisions. QR2	2	0
6.	No phenomenon is a real phenomenon until it is an observed phenomenon. QR2	3	0

7.	Ordinary reality crystallizes out of some less real background through measurement. QR2	1	-2
8.	By choosing freely which attribute to look at, he chooses what attributes a system will seem to possess. QR2	1	-1
9.	We must accept that the entanglement of quantum facts is merely part of an undivided and universal whole. QR3	-1	1
10.	Wave function collapse is not an actual physical event but represents the changes that occurs in our knowledge when we become aware of a measurement result. QR3	-2	2
11.	Far-flung, phase-entangled quantum entities are correlated but not connected. QR3	0	2
12.	What we learn about is not nature itself but is nature as exposed to our methods of questioning. QR3	-1	1
13.	Two worlds come together, get correlated, then start to realize all their mutual possibilities. QR4	0	1
14.	It is not so much the system which is effected by an observation as the observer who becomes correlated to the system. QR4	-1	2
15.	If life anywhere is possible at all, every little "could be", no matter how improbably, exists. QR4	-1	1
16.	To use quantum theory to describe the whole universe, one must accept a reduced role for a single observer. QR4	-1	3
17.	We need to invent a new language more suitable for dealing with quantum entities' quirky world. QR5	-3	0
18.	A non-Boolian logic would make interactions definite and thus resolve the uncertainties and fuzziness that now prevails. QR5	-1	-1
19.	The world obeys a non-human kind of reasoning. QR5	-3	0
20.	If we did have a quantum logic the everyday world would cease to make sense. QR5	0	1
21.	The familiar objects and the quantum entities are the same -- ordinary things. QR6	0	2
22.	It is tempting to resolve the quantum measurement problem with a private radar beam to guide each quantum entity -- all 10 to the 80th of them. QR6	-2	1

23.	Superluminal connects are no accident but a necessary feature of any object-based model of reality. QR6	-2	3
24.	Physicists don't like entities that are in principle unobservable. Pilot waves remind them of angels dancing on the pinhead. QR6	0	0
25.	The world is not objectively real but depends on the mind of the observer. QR7	-2	-2
26.	What is special is not the measuring device but the measuring act. QR7	1	-2
27.	Compared to the "yes or no" world of classical physics, the quantum world resembles a fairy-tale land built solely on ambiguous maybes. QR7	0	-2
28.	Solving the measurement problem means finding the location at which nature makes the quantum jump. QR7	0	-3
29.	Physical existence stands halfway between the idea of the event and the actual event itself. QR8	1	-1
30.	An unobserved quantum entity can entertain in potentia a multitude of contradicting attributes. QR8	1	-1
31.	One of the inescapable facts of life is that all our choices are real choices and taking one path means forsaking all others. QR8	1	0
32.	The world of potentia and the world of actuality is bridged by what physicists call "measurement". QR8	0	-1

Consensus statements (Graphical) 8QR_for 9.sty

Due to the bipolarity of Factor B, there is 1 consensus item

	Factors A	B
24. Physicists don't like entities that are in	0	0

Differentiating statements (Graphical)

4 items distinguish Factor A from all other factors

	Factors A	B
2. Quantum uncertainty is more than just an	3	-3
10. Wave function collapse is not an actual physical	-2	2
16. To use quantum theory to describe the whole	-1	3
23. Superluminal connects are no accident but a	-2	3

– End of log file –