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Richard Johnson has had a remarkable career in an era that integrated the use of computers and mathematical models into marketing research. This article summarizes his contributions in terms of theoretical advances, practical solutions, and the development of a culture that links the academic and practitioner worlds. The author speculates on the personality traits that made Johnson so successful and ways that his critical roles can be fulfilled by others in the future.

What Has Marketing Learned from Richard Johnson?

Thanks to the efforts of Richard Johnson, the way marketing research is thought about and done has changed. The purpose of this article is to characterize some of the ways that his work has altered the profession and speculate about aspects of his character that led to his productivity and the prospects for others to continue this work in the future. Rich has made contributions in basic theory and applied knowledge, but most important, he has been a critical catalyst in bringing so many ideas into general use in the market research community.

Rich was one of a group of psychometric pioneers who used the power of matrix mathematics and computers to help resolve fundamental issues of measurement. Much of the excitement revolved around the development of nonmetric estimation that enabled people's perceptions and values to be estimated by ordinal judgments. With an axiomatic system, it was not necessary to assume linearity of a seven-point semantic differential scale, but instead researchers could build individual scales based on what Clyde Coombs (1964) called "dominance judgments" (i.e., one item is bigger, quicker, or more preferred than another). These early psychometricians developed exciting nonmetric estimation procedures (e.g., Monanova, Linmap, Prefmap) that could produce interval value scales provided that the assumptions (e.g., additivity, triangle inequality) of the model were shown to hold.

Two empirical findings then altered the history and the focus of measurement. First, careful tests of the axioms showed that the assumptions were consistently violated (e.g., Falmange 1976). Second, basic tests showed that treating rating scales as intervals better predicted subsequent choices than the assumption that the scales conveyed only ordinal information (e.g., Huber 1975). However, while the elegant underpinnings of conjoint measurement were under attack, many of the norms and processes of the early psychometricians were appropriated by marketing researchers. Three of the processes developed by the psychometricians proved particularly valuable in the development of marketing research techniques. First, the psychometrician's focus on modeling the individual rather than a pooled market avoided the aggregation fallacy and facilitated the critical identification of segments. Second, marketing researchers borrowed the use of decompositional models, which derived values from judgments on experimentally defined objects. The resulting models enabled analysts to disentangle the impact of otherwise correlated attributes, such as mileage and acceleration. Third, the use of fractional factorial designs facilitated the estimation of multiple attributes on individual respondents with a reasonably limited task.

This paradigm shift was canonized in Green and Srinivasan's (1978) classic article, which distinguished the axiomatic tests in conjoint measurement from the more pragmatic goals in conjoint analysis. At the same time, this migration away from theory-based ordinal construction of utility functions is paralleled in Richard Johnson's adaptive conjoint analysis (ACA), in which he moved from ordered trade-off matrices to graded pair comparisons of selected pairs. What the graded scale loses in terms of theoretical purity, it more than gains in predictive value.

One of his more clever innovations was the use of multiple discriminant analysis for scaling (Johnson 1971). If measures of brand perceptions from different consumers are available, discriminant analysis can predict brands as a function of their attribute perceptions. This unusual use of discriminant analysis locates brands in the space defined by linear combinations of the original attributes. In that space, brands are as distinct as possible in the sense that they have locations that maximize the distance between them while maximizing the agreement across consumers with respect to that location. Compared with principal components analy-

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sis, which maximizes the sum of the between- and within-brand variances, Johnson's process, which maximizes the ratio of variances, has advantages in applied contexts (Huber and Holbrook 1979).

Richard Johnson's pragmatic orientation is revealed in both the mixing of scales in ACA and the creative use of discriminant analysis for perceptual scaling. In simple terms, he found what worked. Sometimes, this market orientation was reflected in new ways to conduct market research (e.g., the disk-based interview system, Ci2), and other times, it involved making cutting-edge theoretical thinking available to the market research community. For example, Sawtooth's offering for choice-based conjoint (CBC) analysis made choice experiments accessible in ways that were possible only with state-of-the-art customized procedures (Louviere and Woodworth 1983). Perhaps the cleverest aspect of that product was the way it finessed the issue of choice design by selecting random but balanced choice sets for each individual. When compared with "optimal" designs (e.g., Huber and Zwerina 1991), these randomized designs do well and have a strong advantage of depending neither on a functional form nor on any prior beliefs about value. The net result is a program that is classic Johnson: It is efficient, robust, and, perhaps most important, accessible to a broad range of researchers.

The collection stage of CBC was also unique to Richard Johnson and Sawtooth. Virtually no other company was marketing randomized designs or a system to deliver those designs through computers or the Web. However, the other element that made the CBC system particularly valuable to the marketing research community was the availability of hierarchal Bayesian analysis. Briefly, Bayesian estimation stabilizes individual parameters by treating them as mixtures of a population distribution and each individual's choices. Richard Johnson had no formal training in Bayesian estimation, but he gained expertise on the procedure from pioneer researchers Greg Allenby and Peter Lenk. In the mid-1990s, Bayesian analysis was difficult to use and was plagued with long run times, lack of convergence, and equivocal interpretation. Richard Johnson took one particular Bayesian model and developed it to estimate the results of CBC. By limiting its applicability, he was able to increase the speed of convergence by an order of magnitude. In addition, the Sawtooth community performed many simulations and tests that have enabled the development of standards and procedures that transformed Bayesian estimation from a black art available only to the tutored few to a standard technique available to all.

Although theoretically CBC has little in common with its predecessor, ACA (adaptive conjoint analysis), from the user's perspective, the shift was quite seamless. A major benefit of ACA is the availability of individual-level value functions that can be used in a choice simulator. The simulator enables the analyst to assess share changes to product lines from modifying the competitive set. This kind of product line simulation is difficult to do with any other method except individually based conjoint. From a user's perspective, the combination of hierarchal Bayes and CBC enables the same simulator output that had been valuable with ACA. In summary, Rich's training in linear algebra and computer implementation, combined with his drive to solve practical problems in marketing research, put him in the ideal position to contribute to the revolution in thought and action.

WHY IS HE SO SUCCESSFUL?

Rich's essay (Johnson 2005) stresses the role of unplanned events and chance in his intellectual development. However, as Louis Pasteur famously observed, chance favors the prepared mind. How was he able to prepare himself to further both knowledge and practice? In my view, Rich possesses three characteristics that contributed to his productivity. First, he has a tendency to leap before he looks. Second, he has an intellectual and personal need to attack new problems. Third, he received support from an independent but loyal base of researchers and customers.

Leap First, Look Later

For Rich, the literature search typically comes later. When faced with a problem, his first response is to attack it head on. A home project example might make this idea clearer. Suppose that a stream requiring a bridge ran across Rich's property. One option would be to buy a book on bridges and then build it according to plan. However, Rich's approach is to build the bridge immediately by drawing on his available intellectual and physical resources. Later, when the bridge collapses in a storm, he would consult the literature or ask his engineer neighbor so that he could learn how the bridge is supposed to be built.

This orientation to build → test → theory certainly runs counter to the way doctoral students are taught to think. They are encouraged to build ideas from theoretical bases. In Rich's case, the subordination of theory arose naturally from his role as a consultant, in which he often did not have the time to test the extension the client required. There are some advantages to the build → test → theory model. First, as Rich mentioned with respect to his early experience, doing factor analyses on hand calculators develops a clear understanding of the basis of the operation. This basis is often lost when using the menu-driven analysis programs that have become commonplace. With respect to the hypothetical bridge scenario, the first attempt to build the bridge provides him with site-specific knowledge of the terrain, the water flow, and the materials that, in general, will not be covered in the literature.

Rich's bridge building has hardly been atheoretical, but understandably it has been based on his own background and orientation. In addition, Rich applies two tests to his models as he builds them that provide applied robustness. First, parallel with the empirical model, he builds a model with simulated respondents to make sure that it can predict back to his assumptions. Second, and perhaps even more important, he floats his early versions through users (either consulting or Sawtooth clients) to ensure that they work in practice. The result is a bridge that may not appear elegant but that serviceably spans the creek.

As an example of how this engineering orientation works, consider again ACA, which merges the prior utility measures derived from a one-to-four ordinal scale with the nine-point degree of difference scale. Green, Krieger, and Agarwal (1991) justifiably criticized the merging of these scales. In response, Johnson (1991) explored different weightings but was unable to find a consistent weighting

that improved on the ACA weights. In separate (unpublished) work with David Hansen, I tested varying weights but found only trivial predictive improvements over ACA's default settings. The point is that the algorithm, honed with the experience of many studies, was robust despite its conflict with normative standards and analyses at the time.

Another advantage with the build → test → theory pathway is related to its impact on the mind-set of the builder. Simply put, building a model creates its own motivation. In contrast, following a prescribed pathway can be as mind numbing as carrying out long division on the blackboard, the Sisyphusian task that nearly drove Rich from mathematics. One of the great thrills in this profession is the ability to put logical organization around an unstructured problem. It seems unfair that we should be denied this simply because someone has structured it before. Educators understand the value of allowing people to develop their own theories. Encouraging students to generate their own solutions and to discover the faults in those solutions makes them ready to understand and ultimately accept the more general solution when exposed to it. By analogy, instead of perceiving Rich's independent development of conditional logit as a waste of time and intellect, it is more appropriate to view it as a way to motivate and increase his understanding of Dan McFadden's (1974) brilliant framework.

Intellectual Wanderlust

Considering the breadth of his contributions, the question arises regarding how Rich could contribute in so many disparate areas. The answer is arguably related to the wanderlust he exhibits in both his intellectual and personal life. Consider where he lives. Rich and his wife, Judy, have never stayed in any location for more than ten years, moving from Cincinnati to Chicago; to Sun Valley, Idaho; to Sequim, Wash.; and, most recently, to Seattle. Each move has been accompanied by a change in formal job reporting, with the move to Seattle characterized by Rich's conscious effort to set Sawtooth Software off on its own. Finally, Rich has enjoyed a dizzying array of avocations—for example, motorcycle riding, airplane flying, downhill skiing, poker—all of which are characterized by a combination of high risk and excitement.

The Importance of a Supportive Base

The quest for change might wear down most mortals, but for Rich it serves to recharge his intellectual batteries. Part of what is different about Rich is his fearlessness, which is derived from an unfounded belief that no matter how steep the hill, how crusty and uneven the surface, he will ski out upright at the bottom. The other part comes from his strategy of having a solid base that supports his risk taking. On a personal level, this base comes from his wife and partner, Judy; their two children; and the rest of his family. On a professional level, Rich has always relied on a set of independent supporters who encouraged him to explore and experiment. Beginning with his advisor, Paul Horst, these are independent people who are willing to support his risky efforts to develop new ideas. This support base includes both consulting clients and Rich's intensely loyal and talented coworkers. It also comes from a group of academic researchers that include John Hauser, Dick Wittink, Peter Lenk, Greg Allenby, Paul Green, and myself.

Perhaps the most critical supportive base is that of Sawtooth Software and its loyal users. Their bonding and mutual support play out in meetings and on their Web site. The open and sharing culture of that organization also contributes to its effectiveness. Sawtooth's culture is unlike that of many market research companies, which are understandably reluctant to limit returns from their investments in methodology by making it easy for others to copy or criticize. Using a different, more open model, Sawtooth has become the dominant worldwide supplier of conjoint software to marketing researchers. The Sawtooth Software meetings share this transparency by inviting as speakers competitors or people with findings that are unfavorable to Sawtooth. Finally, the Sawtooth's Web site provides a way to disseminate best practices as identified by their users.

LESSONS FOR OUR FIELD

Clearly, the field of marketing has gained from the creativity and productivity of Richard Johnson. The questions that arise are related to which of his characteristics should be emulated and what can be done to make it likely that future generations of marketing researchers will benefit from people like him. It would be unwise for most other researchers to follow Rich's iconoclastic research or personal style. Most mortals would not be more productive by trying to solve the problem themselves before thoroughly researching the literature. Furthermore, gains from multiple moves and extreme sports are unlikely to be transferable to others. Still, the lesson for individual researchers may be that there can be a benefit from the depth of understanding that arises from trying to develop something on their own and that personal changes serve to avoid intellectual ruts. The notion that independent research is aided by having a supportive base cannot be denied, even if the cost of building such a base may not equal its benefit for most researchers.

A more difficult aspect to sustain is Rich's role as a disseminator of current marketing research into practice. In the future, who will serve to bring conjoint analysis from a position of an elegant but specialized technique to a standard element of the market researcher's tool kit? Who will make state-of-the-art analysis techniques such as hierarchical Bayes as available as common regression analysis? Who will serve as the critical bridge between academic and practitioner communities?

The answer is that institutions will replace individuals. Under the able leadership of Chris King and Bryan Orme, Sawtooth Software will certainly continue the interactive and open culture that Rich began. The Advanced Research Techniques Forum and Marketing Science Institute will also continue their bridging roles. However, as others have noted, the incentives are not compatible (Green, Johnson, and Neal 2003). That is, as the academic side becomes more specialized and the practitioner side becomes more proprietary, it will become increasingly difficult to bridge the gap between the two.

Indeed, the bridge between theory and practice is likely to become more difficult to build and sustain in the future. Academic research has become increasingly specialized and has neither the time nor the inclination to pursue practical matters. For practitioners, the techniques of marketing

research have become increasingly mature and pragmatic. A parallel can be found in physics, in which Boyle's law enables a person to understand the relationship among volume, pressure, and temperature. However, for practical applications, adjustments must be made with lookup tables that adjust for the interactions of specific gasses. These adjustments are largely empirical rather than theoretical. This dualism has fueled an increasing gap between those who study theoretical physics and the engineers and production managers who must make real decisions. In the same way, refinements in the ways to ask questions or estimate utility functions divide practitioners, who want a useable answer, from theoretical scholars, whose stock in trade derives from the elegance and parsimony of their models. These polarizing forces are not likely to decrease in intensity. Ultimately, future scholars are likely to look back on the effectiveness of Richard Johnson in bridging so many areas and acknowledge that they just do not build them that way anymore.

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