Science Communication and the Rationality of Public Opinion Formation

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Abstract

Because research indicates that people’s value-orientations significantly affect their opinions about advanced technologies some risk scholars argue that technology policy should reflect the recommendations of experts rather than the opinions of a value-driven public. This suggested approach might be bolstered to the extent that people use substantive (value-driven) rather than formal (reason-driven) rationality when assessing the recommendations of experts. We found evidence that people’s opinions indeed are influenced strongly by their substantive rationality. We nevertheless argue that technology policy formation should rely more rather than less upon public opinions, thereby encouraging further efforts at improving science communication theory and practice.

Key words: consumer trust, recreancy theorem, substantive rationality, U.S. food system, cultural cognition project.
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Introduction

If people rely primarily upon their value-orientations to evaluate the recommendations of experts, perhaps in the process hindering the rational development of beneficial technologies used in societal systems, then to what extent should a well-meaning but relatively uninformed public participate in developing technology-related policies? This question has been central to contemporary debates about the extent to which technology-related policy should be guided by expert rather than public opinion (e.g., Culture Cognition Project, 2011; Sunstein, 2005, 2006). This debate might be further intensified to the extent that people use substantive (i.e., value-driven) rather than formal (i.e., reason-driven) rationality in forming their opinions about expert recommendations. That is, if people tend to rely upon their value-orientations rather than their formal reasoning to evaluate the assessments of experts, then does not this finding support claims that public opinions should be secondary to expert opinions in forming reason-based technology-related policy? This paper explored the extent to which people express substantive rationality in evaluating expert recommendations regarding the U.S. food system, wherein agricultural production policy formation represents an arena of intense controversy regarding the role of public opinion. The results indicate that people indeed rely strongly upon substantive rather than formal rationality in evaluating experts’ recommendations. Although these results seemingly support arguments for less emphasis upon science communication in its efforts to encourage public participation in technology policy formation, we argue that the findings support increasing such efforts.
We begin by describing social science perspectives on rationality. Next, we establish a theoretical foundation for empirically testing for expressions of formal and substantive rationality. We then analyze data gathered from two nationwide surveys of U.S. consumers to explore the extent to which they utilize substantive rationality in evaluating expert opinions about the U.S. food system. Next, we briefly summarize the current debate about the extent to which the public should be involved in guiding technology policy. Then, we describe how our findings—which indicate that people rely strongly upon substantive rationality—inform this debate and support increased efforts at improving science communication.

**Social Science Perspectives on Rationality**

Weber's (1968[1921]) treatises on rationality distinguish between *zweckrational* motivations—ones aimed at attaining "rationally pursued and calculated ends" (p. 24-26)—and *wertrational* motivations—ones guided by a "conscious belief in [a] value [orientation] for its own sake" (p. 24). To Weber, *wertrational* expressions have importance to the actor "independently of [their] prospects of success" (Weber, 1968[1921]: 24). *Wertrational* expressions thereby are neither irrational nor nonrational but instead are "induced by immanent or transcendental (as opposed to instrumental) values and thus by intrinsic rather than extrinsic motivation" (Zafirovski, 2005). In distinguishing between *zweckrational* (i.e., formal) and *wertrational* (i.e., substantive) motivations Weber posed a complementary ontological position to that offered in other social sciences, particularly to that offered in economics as the foundation of rational choice theory (e.g., Boudon, 1981; Coleman, 1990; Elster, 1989; Hechter and Kanazawa, 1997; Sen, 1977; Simon, 1982). Rational choice theory posits that individuals in
their decision making seek to maximize their benefits and minimize their costs related to some form of goal-attainment (e.g., Sen, 1977). "Thin" forms of rational choice assume that economic benefits define the first-order ends and motives for goal-attainment whereas "thick" forms of rational choice broaden the definition of potential ends to include non-economic goals, such as prestige, power, influence, and the like, including expressions of value orientations (Elster, 1989; Hechter and Kanazawa, 1997). In either its thin or thick versions the essential element of rational choice is that behavior in some manner is oriented toward achieving an extrinsically identifiable goal, whether this goal be defined by the maximization of economic or non-economic utility (Boudon, 1981; Sen, 1977).

As might be expected the teleological determination inherent within thick rational choice theory, wherein it is assumed that the actor is pursuing "some goal," in addition to its assumptions about full knowledge, intentionality, and transitivity have engendered debate within the social sciences regarding its falsifiability and eventual pragmatic usefulness (e.g., Ackerman, 1997; Sen, 1977; Smelser, 1992). We pass on this debate to explore instead the distinction drawn by Weber between rational behavior oriented toward extrinsically defined goals, whether these goals be economic or non-economic ones (i.e., formal rationality), and rational behavior reflecting intrinsic self-expressions of values that present merits to the actor in and of themselves, ones that have importance to the actor independently of their prospects of success (i.e., substantive rationality). Weber's typology has proved valuable to social scientists in understanding human motivation and in informing approaches to incorporating such motivations within public policy formation (Ritzer, 2010). In considering sound public policy formation, for example, policy makers might wonder about the extent to which public opinions offered only for the sake of expressing value-based orientations (i.e., an expression of substantive rationality)
should be incorporated into policy deliberations. Hence, from an applied perspective empirically validating this distinction might highlight the significance of such expressions as a mechanism by which people support experts’ recommendations (e.g., Kahan, et al., 2006; Kahan and Slovic, 2006; Sunstein, 2005, 2006). And conceptually, such an evaluation would support Weber’s typological distinction between zweckrational and wertrational motivations. We wondered, therefore, about whether expressions of values for the purpose of obtaining an extrinsically-identifiable goal might empirically be differentiated from expressions of values for their own sake.

Such an empirical investigation requires identifying expressions that: 1) seemingly do not reflect zweckrational, or formal rationality, 2) reflect expressions of value-orientations, and 3) reflect value-orientations for their own sake independently of their prospects of success. This third criterion is critical to an empirical investigation of zweckrational and wertrational behavior because from the perspective of thick rational choice theory zweckrational behavior includes expressions of values if such expressions are intended by the actor to further goal-attainment. That is, one might express values in a manner that seemingly cannot be identified as instrumentally logical but intentionally or unintentionally ignore logical inconsistency for the purpose of achieving a broader or longer-term purpose of goal-attainment. Explorations of individuals' choices within decision theory (e.g., Anand, 1993) and prospects theory (e.g., Kahneman and Tversky, 1979), for example, indicate that actors sometimes break with logically consistent and transitive rules because they hold the prospect that by doing so they will attain an extrinsically identifiable goal. An empirical indication of substantive rationality, therefore, must meet all three criteria specified above.
To be certain, such an evaluation cannot exhaust all possible alternative prospects of success an actor might be contemplating. So attempts to empirically evaluate substantive rationality always will be subject to claims that the prospect has not been identified or cannot be achieved due to the conditions of either the actor's limited knowledge and imagination or external structural constraints (see discussions of bounded rationality; e.g., Jones, 1999; Simon, 1982)). Nevertheless, an investigation of possible expressions of substantive rationality might be undertaken within the bounds of a clearly identified external goal to determine if this goal seems to serve as a prospect for success that can explain seemingly nonrational behavior.

**Theoretical Approach to Assessing Rationality**

**The Recreancy Theorem**

Assessing expressions of substantive rationality requires a theoretical framework by which to logically identify such expressions. The recreancy theorem (Sapp et al., 2009), with some conceptual modifications as described below, meets this need. Furthermore, inasmuch as the theorem addresses public confidence in representatives of societal institutions it provides a valid framework for illuminating the importance of science communication within an arena of sometimes conflicting value-orientations about public policy. While recognizing the achievements within psychometrics (e.g., Slovic, 2000), anthropology (e.g., Douglas and Wildavsky, 1982), sociology (e.g., Rogers, 1995), economics (e.g., Gollier, 2004), and social-psychology (e.g., Fishbein and Ajzen, 1975) regarding public support for existing and alternative institutional arrangements, Freudenburg and colleagues (Alario and Freudenburg, 2003; Freudenburg, 1993; Freudenburg and Pastor, 1992; Rosa and Freudenburg, 1984) note several limitations they deem worthy of further conceptualization and empirical examination. These
scholars assert that most approaches to understanding public perceptions of policy focus upon attributes of individual perceivers without paying sufficient attention to the actions taken by institutions responsible for policy development and management. Freudenburg (1993:916) expresses concern about these limitations in light of indications that within the past few decades there has been a dramatic increase in the potential for recreancy—"the failure of institutional actors to carry out their responsibilities with the degree of vigor necessary to merit the societal trust they enjoy." Related to this concern are misgivings about the language used by some risk assessors in classifying as irrational skepticism expressed by citizens regarding public policy. For example, whereas some (e.g., Cohen, 1985; Starr, 1969) consider public rejection of new technologies deemed as sufficiently safe based upon quantitative risk assessments to be irrational, Freudenburg et al. point out the inherent rationality of expressing skepticism towards societal institutions that too often neglect their obligations to conduct quantitative risk assessments in a scientifically objective manner, adequately inform the public about known risks, and manage risks with due regard to public safety. Drawing principally upon the work of Barber (1983), Freudenburg (1993) posits that institutional representatives require competence—the skills, abilities, and experience needed to successfully complete a task—and fiduciary responsibility—the integrity required to do the right thing. Freudenburg et al. thereby propose that assessments of consumers' trust in and support for institutional arrangements should focus upon their assessments of these attributes of institutional actors. In accordance with this conceptual approach, Freudenburg (1993) asserts that citizens' evaluations of institutional recreancy—and their related assessments of the competence and fiduciary responsibility of societal institutions—reflect elements of both formal and substantive rationality. Freudenburg (1993) reasons that theoretical approaches to understanding public perceptions of recreancy that
presume that these perceptions are based upon expressions of formal rationality only
conceptually cannot account for the extent to which such perceptions are based upon expressions
of value-orientations.

Subsequently, Sapp and colleagues (Sapp, et al., 2009; Sapp and Downing-Matibag, 2009) relied upon this perspective to posit the recreancy theorem as an approach to understanding public support for institutional arrangements, wherein this support presumably is based primarily upon individuals' judgments of the competency and fiduciary responsibility of institutional actors. Quantitative investigations of support for selected institutional actors across five areas of the U.S. food system (Sapp, et al., 2009) and public acceptance of irradiated food (Sapp and Downing-Matibag, 2009) found empirical support for the recreancy theorem. That is, these investigations found that public perceptions of the competency and fiduciary responsibility of institutional representatives explained a significant amount of the variance in trust in and support for them whereas individual attributes such as social-demographic characteristics and perceived risk had only modest influences upon trust and support. Finding empirical support for hypotheses specified by the recreancy theorem, however, does not imply support for the theoretical propositions from which these hypotheses are derived. Such reasoning represents the fallacy of affirming the consequent, or believing that a set of observed relationships necessarily lends support to the propositions used to specify these relationships (e.g., Sarkar and Pfeifer, 2006). The conceptual foundations of the recreancy theorem infer that people will exhibit both formal and substantive rationality in their evaluations of societal institutions. Therefore, to improve social science understanding of citizens' trust in and support for societal institutions we explored within the context of the recreancy theorem the extent to which expressions of formal and substantive rationality might be identified in evaluations of these institutions. Earle and
colleagues (Earle, 2010; Earle and Cvetkovich, 1995; Earle and Siegrist, 2006; Earle, et al.,
2007; Siegrist, et al., 2003) describe theoretical linkages between rationality and trust that inform Possible procedures for empirically examining expressions of formal and substantive rationality within the context of the recreancy theorem.

Rationality and Trust

Earle and colleagues posit the trust, confidence, and cooperation (TCC) model as an approach to understanding individuals' expressions of trust in others. In relying principally upon the work of Luhmann (1979), they distinguish between within-group trust—exemplified either by trust based upon limited information (i.e., "social trust") or upon repeated interaction (i.e., "interpersonal trust")—and across group trust (i.e., trust among strangers, or "general trust"). In contrast, Sapp et al. (2009) in relying upon the work of Luhmann (1979) and Barber (1983), refer to trust based upon repeated interaction as relational trust (e.g., 'I trust my grocer') and interpret the term "interpersonal trust" to mean "the perceived bond between a specific agent and the trustee" (e.g., "I trust grocers") (2009:528). Thus, the TCC model, which addresses the determinants of social trust, and the recreancy theorem seem to refer to a similar expression of vulnerability—that is, one deferred to societal agents for whom the actor has limited information. Earle et al. define confidence "as the belief, based on experience or evidence, that certain future events will occur as expected" (2007:4). The TCC model then posits that the actor's perceived performance of the agent to be trusted will have a direct effect on their evaluations of confidence. The recreancy theorem, in contrast, distinguishes between two beliefs that might influence actors to assume that certain future events will occur as expected: perceived competence—evaluations of the skills, abilities, and expertise of the agent to be trusted (i.e., can the agent successfully complete a desired task)—and perceived fiduciary responsibility—
evaluations of whether the agent has the integrity to do the right thing (i.e., will the agent successfully complete a desired task). Thus, both the TCC model and the recreancy theorem focus upon expressed vulnerability to within-group agents for whom the actor has limited information and specify that actors' performance evaluations of agents will affect their expressed trust in them. One noteworthy difference between the two approaches is the significance placed within the TCC upon shared values. Earle et al. (2007) assert that perceived shared values represent an essential theoretical link between individuals' general trust and their expressions of social trust in within-group agents. In that the TCC model specifies the critical nature of perceived shared values on evaluations of agents it emphasizes a theoretical element that might influence evaluations of both competence and fiduciary responsibility within the recreancy theorem. It is this insight into the determinants of trust that lead us to posit an extension to the recreancy theorem, one posited for the purpose of exploring expressions of formal and substantive rationality within it.

The expanded recreancy theorem (Figure 1) specifies that perceived competence and fiduciary responsibility reflect the actor's sense of shared values with the agent to be trusted (with respect to pursuing a particular agricultural production goal). In this sense the expanded theorem incorporates insights offered by Earle et al. regarding actors' trust in and support for institutional arrangements. Previously unspecified by Earle and colleagues but informative here is a consideration of the conceptual meanings of perceived shared values on judgments about both competence and fiduciary responsibility. The hypothesized relationship between perceived shared values and evaluations of fiduciary responsibility seems to conform with the description of formal rationality. That is, it seems like a logical means-ends relationship to assume that a perception of shared values with an agent would influence the actor to believe that the agent will
"do the right thing." On the other hand, the hypothesized relationship between perceived shared values and evaluations of competence does not seem to meet the requirements of formal rationality because a sense of shared values seems to provide neither a necessary nor sufficient condition to infer competence. For example, Stephanie might believe that Natalie shares her same values but has not the competency to successfully carry out her task-related responsibilities. Conversely, Stephanie might believe that Natalie does not share her same values but recognizes that Natalie nevertheless is highly competent at carrying out her task-related responsibilities. The specified path between shared values and competency, therefore, might reflect some type of rationality, but inasmuch as it does not represent a logical connection between means and ends cannot in itself represent formal rationality. Nor is it likely that such an expression be deemed as irrational, at least within the scope of contemporary social science definitions of rationality (e.g., Zafirovski, 2005).

The question becomes, then, does this seemingly nonrational expression of values represent an extension of rational choice in that it is directed toward goal-attainment (i.e., thick rational choice) or does it reflect an expression of values in themselves (i.e., substantive rationality)? Thick forms of rational choice theory might consider this relationship as an expression of formal rationality in that it reflects attributed competence for the prospects of attaining an extrinsically identifiable goal. For example, although Stephanie might believe that Natalie does not have the competence necessary to successfully complete a task she nevertheless might attribute competence to her as a means of encouraging her to attain an extrinsically identifiable goal (i.e., "I desire for Natalie to be successful"). Alternatively, this expression might reflect substantive
rationality in that it represents an assertion of values in themselves without regard for the prospects of success. For example, although Stephanie might believe that Natalie does not have the competence necessary to successfully complete a task she nevertheless might attribute competence to her as a means of expressing her value-orientation regardless of whether the task is successfully completed (i.e., "I wish to express my support for Natalie's values"). We propose that empirically evaluating this distinction is an important undertaking as a means of gaining further understanding of the significance placed upon perceived shared values in people’s support for experts’ recommendations.

**An Examination of Rationality Within the Recreancy Theorem**

**Samples**

The data were collected in two nationwide surveys of adults, ages 21-65, conducted in 2011. Survey Sampling International (SSI) provided access to their internet panels, consisting of adults recruited through web-related contacts. The response rates for each survey equaled approximately 25 percent. Although approximately 70 percent of homes in the U.S. have access to the internet (U.S. Bureau of the Census 2010), given that less-affluent homes are less likely to have an internet connection one should take caution in generalizing to the population the descriptive results observed in these samples. To some extent the degree to which social class might affect our investigation of expressions of formal and substantive rationality within the recreancy theorem can be evaluated with respect to how strongly measures of social class affect trust in and support for the U.S. food system.

Respondents in Survey 1 were asked for their opinions in regard to the model variables with respect to the activities of "family" farmers. And respondents in Survey 2 were asked for their
opinions about the activities of "commercial" farmers. Family farming was defined for respondents as, "This is a farming operation that is owned and operated by a family. All decisions on how to operate this farm are made by the family members and carried out by family members or employees." Commercial farming was described as, "This is a farming operation that is owned by a company and operated by employee farmers. All decisions on how to operate this farm are made by managers of the company and carried out by employees." Such definitions, as would others, present some ambiguity with regard to what is meant by the distinction between family and commercial farming. After all, much of family farming is conducted within the context of a family-owned corporation. Therefore, distinctions that might be drawn between the two types of farming are largely immaterial here inasmuch as we focus upon expressions of rationality with regard to evaluations of representatives of them. Nevertheless, these definitions seem to have been sufficient to create statistically significant differences in expressed opinions about the U.S. food system across the two surveys, differences that might reflect the propositions advanced by Earle et al. (2005) regarding how cultural context can affect the interpretation of theories of rational expectations such as the recreancy theorem.

Measurement of Model Variables

Support for the recommendations of farmers was measured by responses to the request, "Please tell us…the extent to which you are willing to support the actions of [family/commercial] farmers who [agricultural goal]." As in the measurement of all model variables, responses were recorded on an 11-point scale, wherein 0 = low (support, trust, etc.) and 10 = high (support, trust, etc.). We described trust as "a combination of how competent you believe farmers are (knowledge, skills, and experience) and how confident you are in relying
upon them to do the right thing." Trust was measured by responses to the request: "Please tell us how much trust you have in farmers who [agricultural production goal]." Perceived competence was measured by responses to the request to, "tell us the degree to which you believe farmers have the competence to achieve a specific goal. Do they have the knowledge, skills, and experience to do a good job?" We defined fiduciary responsibility (i.e., confidence) as "doing the right thing." To measure fiduciary responsibility we asked respondents to tell us how much confidence they had in farmers who [agricultural production goal]. Perception of shared values was measured by responses to the request to "tell us the degree to which you believe farmers share the same values as you do" regarding [agricultural production goal]. Conceptually, it is important to account for variance in perceived shared values that might be related to support for the agricultural goal being considered. Therefore, our model estimations included a statistical control for the correlation between perceived shared values and perceived competency.

We included in the model the following characteristics of respondents as statistical controls for their expressions of trust in and support for the goal-orientations of farmers: age (in years), sex (0 = male, 1 = female), years of formal education (less than high school, high school, vocational or technical school, undergraduate college degree, Masters degree, PhD degree or other doctorate degree), and income (less than $25,000, $25,000 - $49,999, $50,000 - $74,999, $75,000-$99,999, $100,000 - $249,999, and $250,000 or more). Given that psychometric research has identified perceived risk as a key determinant of trust and support (e.g., Slovic 2000, Frewer et al. 1996), we included a measure of concern about agricultural production goals. We asked respondents to "tell us concerned they were about": the rising cost of food, humane treatment of animals, having enough food to feed the world, environmental sustainability in farming, and food safety.
Procedure

Our procedure required that we know the extent to which respondents' supported selected goals of production agriculture. Thus, in each survey we asked respondents to assign a total of 100 points to express their opinions about the extent to which farmers should pursue eight agricultural production goals: grow affordable food for me and my family, assure humane treatment of farm animals, grow enough food to help feed the world, assure environmental sustainability on the farm, assure food is grown safely, assure food is nutritious, assure farm profitability, and maximize farm productivity. We reasoned that one approach to empirically differentiating expressions of formal from substantive rationality within the context of the expanded recreancy theorem would be to examine the moderating effects of goal-orientation on the relationship between perceived shared values and evaluations of competency. One might presume, for example, that persons who strongly support, for example, environmental sustainability—as measured by the strength of their desire to attain this goal—would be more likely to attribute competence perhaps even without a sense of shared values. It is within this understanding that we assessed the extent to which formal and substantive rationality might be expressed within the recreancy theorem. Of course, such an evaluation will leave much to debate given the many alternative goals that might have been pursued by respondents in their evaluations of shared values and competency. This indeterminacy cannot be avoided in empirical evaluations of thick rational choice (e.g., Sen, 1977). We will, however, be able to examine expressions of formal and substantive rationality with respect to goals clearly identified to the survey respondents and to which their responses were directed. Furthermore, we believe that apart from the extent to which such an evaluation supports an empirical validation of
expressed substantive rationality it can reveal the importance of perceived shared values in individuals' expressions of trust in and support for the U.S. food system.

Our procedure was to use structural equation modeling (Jöreskog and Sörbom, 1995) to estimate the causal relationships posited by the expanded recreancy theorem for each of five agricultural production goals: (i.e., affordable food for me and my family, animal welfare, environmental sustainability, grow enough food to feed the world, and safe food). We explored, first, the extent to which the hypotheses specified by the recreancy theorem were supported by the data. Next, we investigated whether the specified relationships between perceived shared values and perceived competence and fiduciary responsibility were supported by the data. Next, we reasoned that finding a statistically significant parameter estimate for the relationship between perceived shared values and perceived competence that was significantly moderated by the actor's degree of interest in attaining the goal under consideration would represent an expression of formal rationality. That is, such a finding would support the proposition that actors were expressing their values as encouragement for the prospects of success. We reasoned further that finding a statistically significant parameter estimate for the specified relationship between perceived shared values and perceived competence that was not significantly moderated by the actor's degree of interest in attaining the goal under consideration would represent an expression of substantive rationality. This assertion rests upon the assumption that the latter finding would indicate an expression of values without regard to the prospects of success in attaining the goal under consideration. Thus, our central hypothesis is that the relationship between shared values and perceived competency will be moderated by the extent to which one supports the agricultural production goal under consideration (i.e., which would reflect an expression of formal
rationality). A rejection of this hypothesis in favor of the null presumably would provide an
indication of an expression of substantive rationality.

Results

The median category for respondents' age was 35-44 with the distribution leaning toward
older age categories, wherein approximately 25 percent of respondents were ages 55-65 (Table
1). Approximately 52 percent of respondents were males. The median category for respondents'
education was "vocational/technical." Approximately 48 percent of the survey respondents had
earned a college degree or higher thereby reflecting a sample with higher educational attainment
than that of the U.S. population, wherein about 27 percent of Americans report earning a college
degree or higher (U.S. Census Bureau 2007). For both samples, the median category for total
household income before taxes in 2010 was $50,000-$74,999, which corresponds with the 2009
median income category for U.S. households (U.S. Census Bureau 2007).

[Table 1 About Here]

The mean values for all model variables for both samples were above the response scale mid-
point of 5.0 (figures available upon request). The mean evaluation of the competency of family
farmers to "feed the world" equaled just 5.123, whereas the mean evaluation for support of
family farmers to produce safe food equaled 8.418. We found that the evaluations of
commercial farmers with just three exceptions were for every topic and model variable
statistically different from those observed for evaluations of family farmers. In some cases the
evaluations for commercial farmers were higher and in some cases lower than the evaluations of
family farmers. The numerical differences in evaluations typically were small ones, wherein the
indication of statistical significance in part reflects the large sample sizes for the two surveys.
We estimated the model depicted in Figure 1 using the data gathered from both samples for those topics for which we had full information for potential goals (i.e., affordable food for me and my family, animal welfare, environmental sustainability, grow enough food to feed the world, and safe food). These ten evaluations of the recreancy theorem showed support for its propositions (Table 2). That is, the explained variance in trust and support, the size and statistical significance of the standardized effects of perceived competence and fiduciary responsibility on trust, and the statistics regarding overall model fit indicated that the model has adequate explanatory power and construct validity to serve as a theoretical approach to understanding consumer trust in the U.S. food system. Across the ten evaluations, the R-square values indicating explained variance in trust ranged from .62 to .69. The R-square values for explained variance in support ranged from .40 to .55 regarding the recommendations of family farmers and from .24 to .43 regarding the recommendations of commercial farmers. As has been noted in previous evaluations of the recreancy theorem (Sapp et al. 2009), the effect of perceived fiduciary responsibility on trust outweighed that of perceived competence on trust—across the ten models tested here, by an average margin of approximately 3 to 1.

[Table 2 About Here]

The parameter estimates for the effects of perceived shared values on perceived competence and fiduciary responsibility all were statistically significant at prob. < .01, as was the case for the parameter estimates for all the modeled independent variables (i.e., shared values, competence, fiduciary responsibility, and trust). We found that the standardized parameter estimates for the effect of perceived shared values on perceived competence (i.e., a possible indication of substantive rationality) were for the ten evaluations of the expanded recreancy theorem nearly as large or larger than the estimates for the effect of perceived shared values on perceived fiduciary
responsibility (i.e., a presumed indication of formal rationality). The critical issue here is whether these statistically and substantively significant parameter estimates for the effects of shared values on perceived competence (i.e., ranging in size from .499 to .682) were moderated by how strongly respondents desired for the goal under consideration to be realized.

We calculated the product of perceived shared values and goal-orientation to measure the extent to which the interaction between these two variables moderated the effect of perceived shared values on perceived competency. Our procedure was to conduct a chi-square difference test (Bollen 1989) for the significance of the path between perceived shared values and perceived competency wherein the baseline model contained just the main effects of perceived shared values and goal orientation and the test model included the measure of the interaction between these two variables. We found for 9 of the 10 evaluations of the expanded recreancy theorem that the relationship between perceived shared values and perceived competency was not moderated by the extent to which the goal under consideration was desired by the respondent (Table 3). Therefore, as much as might be possible to ascertain within reasonable limits of empirically testing alternative goals, in 9 of 10 models we found an indication of expressed substantive rationality. It seems, therefore, for most applications of the model that respondents were expressing values for their own sake without necessarily doing so for the prospects of success—an indication of expressing substantive rationality.

[Table 3 About Here]

The expanded model included five covariates wherein each was specified as having a direct effect on expressions of trust in and support for farmers: age, sex, education, income, and concern about the goal under consideration. The mean percentage contribution to the explained
variance in trust for perceived competence, perceived fiduciary responsibility, the combined
effects of the social demographic variables, and expressed concern were 10.34%, 88.17%,
0.40%, and 1.09%, respectively. Thus, the social-demographic variables and expressed concern
about the goal under consideration had just small relative contributions to the explanation of
expressed trust in farmers (analysis based upon an evaluation of Type-III sum of squares). The
mean contributions of trust and the combined social-demographic variables to the explained
variance in support equaled 74.68% and 1.95%, respectively. The mean percent contribution of
concern about the goal under consideration to the explained variance in support for farmers
equaled 23.37%, an effect size supported by psychometric studies of risk perceptions (e.g.,

Discussion

Evaluation of the Recreancy Theorem

Because the findings here replicate previous studies indicating support for the recreancy
theorem, we believe the theorem's explanatory power is sufficient to warrant its application to
understanding key determinants of trust in representatives of the U.S. food system. Additionally,
we believe the theorem's parsimony can be appealing to practitioners in that it focuses attention
upon just two determinants of trust: perceived competency and fiduciary responsibility, both of
which are subject to change as a result of actions taken by food system representatives. The
value of the recreancy theorem is that it addresses the extent to which the public believes that
representatives of societal institutions have the necessary skills and integrity to adequately fulfill
their responsibilities to the public. It should be noted, however, that the theorem provides no
insight into the psychological mechanisms by which perceptions are formed, including the
incorporation of the many heuristics people use to form their beliefs (see: Slovic, 2000; Sunstein, 2005). Similarly, the expanded model examined here does not identify which values (e.g., Douglas and Wildavsky, 1982) might affect consumers' evaluations of competency or fiduciary responsibility or their trust in and support for representatives of the U.S. food system. Nor does the model account for the sociological mechanisms that influence the social construction of perceptions (see discussions of social cascades and group polarization as reviewed, for example, by Sunstein, 2006; see also the literature regarding the diffusion effect (i.e., Rogers, 1995)).

In summary, the recreancy theorem excels in its simplicity to identify the key determinants of trust. However, because the model provides little guidance into what factors influence these perceptions one can be left wondering how to interpret estimations of it. This study sought to address this issue in a general sense by empirically examining the extent to which consumers express substantive rationality in their evaluations of expert recommendations regarding the U.S. food production system. We found, at least within the context of our procedures, evidence that consumers express both substantive and formal rationality in such evaluations. The significance of this finding can be illustrated by considering it within the context of contemporary civic discourse regarding the extent to which public values should be incorporated within social policy formation. We explore this line of inquiry specifically with regard to consumer perspectives of U.S. agricultural production goals.

Applied Implications of the Findings

Much of contemporary debate about the extent to which the public should be involved in technology policy formation centers upon issues in agricultural production (e.g., Sunstein, 2005, 2006), wherein U.S. consumers express their opinions about agricultural practices through their
adoption or rejection of new technologies (e.g., Israel and Hoban, 1992; Sapp and Korschning, 2004) and their advocacy for legislative changes in agricultural policies (e.g., Auld, 1990; Humane Society of the United States, 2011; Lovvorn and Perry, 2009; Lulka, 2011; Sierra Club 2011). Within the past decade especially consumers have successfully pursued legislative solutions, particularly with regard to addressing environmental and animal welfare issues, typically lobbying for what experts consider to be less rational technologies (e.g., Croney, 2010). As expected, however, citizens' pursuit of legislative solutions raises questions about the extent to which social policy should be determined by people whose opinions are relatively uniformed and sometimes reflect ineffective use of decision-making heuristics (see especially reviews by Dietz and Stern (2008) and Renn (2008)). Sunstein (2005), for example, in assessing public responses to genetically modified food products, proposes that because people's opinions always will be influenced by a lack of full knowledge and the use of heuristics that often mislead them regarding actual risks (i.e., as determined by expert risk analysis), a deliberative society is best served by having expert panels listen to citizens' value expressions but develop social policies that conform with scientific findings. He thereby argues that expert panels should be the principal agents in forming social policy—policy that is guided by values but not by blunders. Of course, ample evidence exists to note that the enterprise of science itself is guided by politics, economics, religious beliefs, culture, and the like (e.g., Freudenburg, 1988; Shrader-Frechette, 1991). And sound scientific evidence might be superseded by the implementation of politically expedient social policies. For example, whereas civic leaders in the European Union might recognize that restrictions placed upon imports of genetically modified food arising from consumer-voiced safety concerns are unsupported by scientific evidence they might nevertheless impose such restrictions to appease concerned consumers (e.g., Carter and Gruere, 2003). As a
further potential limitation of the expert panel approach one wonders about the extent to which a skeptical public will accept the idea of social policy being influenced for the most part by panels comprised of persons whom they mistrust (Croney, 2010). Fischhoff (1995), for example, notes that approaches that ignore public opinion, present just the facts, interpret the facts for the public, or rely upon other strategies that represent a one-way communication from risk experts to the public have in the past failed both to adequately inform public opinions and achieve public support. Therefore, within a democratic society it might be unrealistic to presume that citizens will delegate social policy decision-making to expert panels. Nevertheless, Sunstein (2005) echoes the sentiments of others (e.g., Goklanv, 2001; Graham, 2004; Hanekamp, 2006; Powell, 2010) in advocating for a greater influence of science-based expert opinion when designing social policies.

In contrast to this position, Kahan and colleagues (e.g., Culture Cognition Project, 2011) contend that greater attention should be paid to the value-based expressions of citizens. They assert that the key determinants of trust in and support for social policies are the value-orientations that citizens use to inform their policy preferences rather than the heuristics they use to interpret risks. Relying upon the grid-group typology advanced by Douglas and Wildavsky (1982), Kahan and colleagues propose that effective and acceptable social policies can be achieved when they elicit a sense of shared values among persons/groups with differing value-orientations. It should be noted that value-orientations do not necessarily predict social policy preferences. For example, a person with an egalitarian value-orientation and a global vision might support the agricultural production goal to "grow enough food to help feed the world." A person with an egalitarian value-orientation and a vision limited to "America first," on the other hand, might oppose this goal. Thus, as Sunstein (2006) notes, the culture cognition approach
might simply represent one form of bounded rationality. Nevertheless, the findings of Kahan and associates support the claim that policies that give people a sense of shared values can be effective in gaining consensus support. Recent legislative action regarding egg production, for example, represents in part a reconciliation among institutional representatives who express differing value-orientations (e.g., Humane Society of the United States, 2011).

It should be recognized that some persons even if they hold strong opinions do not necessarily wish an audience for them among policy makers. And to the extent that one believes that experts share their values then one might feel comfortable with policy being guided by these experts. Yet it is not uncommon, especially within the arena of agricultural production policy formation for expert opinions to differ substantially from those of a public that has only their value-orientations to offer as justification for policy alternatives. For example, whereas experts in a recent policy debate strongly agreed that the current size of hen cages were scientifically justified, U.S. consumers successfully voiced their value-oriented opinions that cages needed to be larger (Humane Society of the United States, 2011). In this sense, although public opinions might be relatively uniformed, they nevertheless are important to policy formation and not necessarily irrational in content. To the extent that citizens wish to be heard, therefore, the question for a democratic society becomes to what extent should policy makers heed the advice of relatively uniformed citizens in lieu of the advice offered by experts?

Our findings can be interpreted to support either of the two perspectives described above. To the extent that the findings here demonstrate an intrinsic importance to value expression they support social policy formation that facilitates reconciliations among groups/people with diverse value-orientations. This approach, however, might be frustrated if citizens are expressing their values with no desire to attain an externally identifiable goal, as would be the case when these
expressions represent instances of substantive rationality. In this case, pursuing such approaches will be ineffective to the extent that values are entrenched. Alternatively, in indicating that citizens to some extent express their values with no extrinsically identifiable rationale in mind, the findings here support social policy formation that accentuates decisions made by expert panels. After all, if citizens express their values with no more rationale than their desire to do so then it seems prudent for a nation to provide expert guidance to social policy formation. However, along these same lines the findings indicate that expert panel approaches—ones that listen to but overrule citizens' value-orientations—might be difficult to implement because people strongly desire value-expression. Also, implementing such approaches might foment distrust in societal institutions to the extent that they are perceived as being insensitive to citizens' values.

In conclusion, finding that consumers seemingly use both substantive and formal rationality to evaluate the U.S. food system presents challenges to gauging the extent to which consumer opinions should be incorporated into social policy formation. If indeed it is unrealistic to implement expert panel approaches to social policy formation then the most successful approach to achieving acceptable U.S. agricultural production policies, even if in some cases this approach might be either inefficient or ineffective, will involve actions taken by agricultural producers, agribusiness firms, and agriculture-related government institutions to develop goals and pursue agricultural production practices that are based upon mutual understandings and shared values with consumers. With these considerations in mind, we believe our results indicate that developing both well-reasoned and publically acceptable technology-related policy will require greater rather than less emphasis upon furthering effective science communication theory and practice.
References


Figure 1. The Expanded Recreancy Theorem
Table 1. Descriptive Statistics for the Two Samples.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sample Assessing Family Farmers (n = 1,000)</th>
<th>Sample Assessing Commercial Farmers (n = 1,004)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 – 25</td>
<td>195</td>
<td>19.50</td>
</tr>
<tr>
<td>26 – 34</td>
<td>199</td>
<td>19.90</td>
</tr>
<tr>
<td>35 – 44</td>
<td>155</td>
<td>15.50</td>
</tr>
<tr>
<td>45 – 54</td>
<td>263</td>
<td>26.30</td>
</tr>
<tr>
<td>55 – 65</td>
<td>188</td>
<td>18.80</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>487</td>
<td>48.70</td>
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<tr>
<td>Female</td>
<td>513</td>
<td>51.30</td>
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<td><strong>Education</strong></td>
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<td></td>
</tr>
<tr>
<td>Less than H.S.</td>
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<td>1.90</td>
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<tr>
<td>High School</td>
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<tr>
<td>Vocational/Technical</td>
<td>202</td>
<td>20.20</td>
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<tr>
<td>College Degree</td>
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<td>37.50</td>
</tr>
<tr>
<td>Master's Degree</td>
<td>96</td>
<td>9.60</td>
</tr>
<tr>
<td>PhD or other Doctorate</td>
<td>24</td>
<td>2.40</td>
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<tr>
<td><strong>Income</strong></td>
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<td></td>
</tr>
<tr>
<td>Less than $25,000</td>
<td>207</td>
<td>20.70</td>
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<td>$25,000 - $49,999</td>
<td>292</td>
<td>29.20</td>
</tr>
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<td>$50,000 - $74,999</td>
<td>278</td>
<td>27.80</td>
</tr>
<tr>
<td>$75,000 - $99,999</td>
<td>109</td>
<td>10.90</td>
</tr>
<tr>
<td>$100,000 - $249,999</td>
<td>104</td>
<td>10.40</td>
</tr>
<tr>
<td>$250,000 or More</td>
<td>10</td>
<td>1.00</td>
</tr>
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</table>
Table 2. Standardized Parameter Estimates\(^1\) and Model Statistics for the 10 Evaluations of the Recreancy Theorem.

<table>
<thead>
<tr>
<th>Model Paths</th>
<th>Affordable Food</th>
<th>Animal Welfare</th>
<th>Env. Sus.</th>
<th>Feed the World</th>
<th>Safe Food</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FF(^2) CF(^3)</td>
<td>FF CF</td>
<td>FF CF</td>
<td>FF CF</td>
<td>FF CF</td>
</tr>
<tr>
<td>Shared Values → Competence</td>
<td>.664 .522</td>
<td>.579 .498</td>
<td>.609 .535</td>
<td>.566 .529</td>
<td>.682 .573</td>
</tr>
<tr>
<td>Shared Values → Fiduciary Resp.</td>
<td>.618 .618</td>
<td>.614 .573</td>
<td>.547 .625</td>
<td>.543 .595</td>
<td>.644 .618</td>
</tr>
<tr>
<td>Competence → Trust</td>
<td>.201 .178</td>
<td>.219 .133</td>
<td>.266 .187</td>
<td>.278 .263</td>
<td>.246 .154</td>
</tr>
<tr>
<td>Fiduciary Resp. → Trust</td>
<td>.651 .698</td>
<td>.634 .738</td>
<td>.559 .669</td>
<td>.591 .621</td>
<td>.635 .705</td>
</tr>
<tr>
<td>Trust → Support</td>
<td>.492 .422</td>
<td>.473 .362</td>
<td>.530 .408</td>
<td>.632 .543</td>
<td>.569 .412</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model Statistics</th>
<th>R-square: Support</th>
<th>R-square: Trust</th>
<th>Chi-square (d.f. = 28)</th>
<th>Adjusted Goodness-of-Fit Index</th>
<th>Critical N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.40 .28</td>
<td>.48 .32</td>
<td>136.31 147.60 152.03 159.11</td>
<td>.939 .934 .935 .931</td>
<td>354.83 329.08</td>
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<tr>
<td></td>
<td>.44 .33</td>
<td>.65 .68</td>
<td>182.23 190.89 140.05 89.63</td>
<td>.925 .970 .940 .960</td>
<td>318.25 305.33</td>
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<tr>
<td></td>
<td>.55 .43</td>
<td>.62 .64</td>
<td>192.34 190.89 140.05 89.63</td>
<td>.945 .970 .940 .960</td>
<td>265.66 254.68</td>
</tr>
<tr>
<td></td>
<td>.43 .24</td>
<td>.69 .68</td>
<td>140.05 89.63 124.30 156.88</td>
<td>.945 .970 .940 .960</td>
<td>345.39 341.28</td>
</tr>
<tr>
<td></td>
<td>.30 .47</td>
<td>.69 .66</td>
<td>156.88 156.88 124.30 156.88</td>
<td>.945 .970 .940 .960</td>
<td>389.02 309.67</td>
</tr>
</tbody>
</table>

1. All parameter estimates are statistically significant at prob. < .01.
2. Estimates and statistics for the respondent evaluations of Family Farmers (n = 1,000).
3. Estimates and statistics for the respondent evaluations of Commercial Farmers (n = 1,004).
Table 3. Examination of the Moderating Effect of Goal-Orientation on the Relationship Between Shared Values and Perceived Competency.

<table>
<thead>
<tr>
<th>Model</th>
<th>Sample Assessing Family Farmers (n = 1,000)</th>
<th>Sample Assessing Commercial Farmers (n = 1,004)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chi-Square</td>
<td>d.f.</td>
</tr>
<tr>
<td>Affordable Food</td>
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<td></td>
</tr>
<tr>
<td>Baseline Model¹</td>
<td>136.308</td>
<td>28</td>
</tr>
<tr>
<td>Test Model²</td>
<td>136.287</td>
<td>27</td>
</tr>
<tr>
<td>Animal Welfare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline Model</td>
<td>152.025</td>
<td>28</td>
</tr>
<tr>
<td>Test Model</td>
<td>150.329</td>
<td>27</td>
</tr>
<tr>
<td>Env. Sustainability</td>
<td></td>
<td></td>
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<tr>
<td>Baseline Model</td>
<td>182.233</td>
<td>28</td>
</tr>
<tr>
<td>Test Model</td>
<td>181.108</td>
<td>27</td>
</tr>
<tr>
<td>Feed the World</td>
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<tr>
<td>Baseline Model</td>
<td>140.047</td>
<td>28</td>
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<tr>
<td>Test Model</td>
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<tr>
<td>Safe Food</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline Model</td>
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<td>28</td>
</tr>
<tr>
<td>Test Model</td>
<td>122.302</td>
<td>27</td>
</tr>
</tbody>
</table>

1. The baseline model is the expanded recreancy theorem (see Figure 1).
2. The test model is the expanded recreancy theorem testing for a potential moderating effect of goal orientation on the relationship between perceived shared values and perceived competency.

** The difference in chi-square at 1 degree of freedom is statistically significant at prob. < .01.