PRAGMATIC PUBLIC POLICY: APPLYING PSYCHOPHYSICS TO THE WORLD OF ATTITUDES

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Abstract

The question we address in this paper is how to create a database of the citizen's mind about anxiety-provoking situations in the face of terrorism. The approach we use is grounded in a combination of experimental design, psychophysics, and consumer research. To this end we ran a set of 15 studies (Deal With It!) using conjoint analysis in order to understand how consumers respond to anxiety-provoking situations. The approach identifies the mindset towards terrorism at the individual respondent level. By exploring responses to terrorism embedded in a general study of 'dealing with anxiety provoking situations' it becomes possible to understand the algebra of the individual respondent's mind; how important the basic fear of terrorism actually is, how important it is to specify the type of terrorism (e.g., bombing versus contamination of the food supply), and the structure of what is frightening the consumer. What are the critical drivers of anxiety -- the specific terrorist act, the location of the act, the feelings, or even the proposed remedies to reduce anxiety? The outcome of the research is both an empirical dataset, and the beginnings of a new sub-discipline in social science, called tentatively 'Prescriptive Public Policy' (PPP). PPP uses psychophysical approaches to understand the problems as a scientist would in his search for general patterns of relations between variables (nomothetic), to solve a particular communications problem as an engineer would, and to understand the individual mind, as a clinical psychologist would (idiographic).

Scaling issues

Methods to evaluate social anxiety after specific events vary widely because of differences in the populations involved, the nature of the events, and the methodologies used in the studies. For example, in quantitative research the structured interview can be augmented with different types of scales varying from a simple 6 point Likert scale for anxiety-related interference with the activities of daily life (1="not at all" to 6="almost all of the time"), onto classic scales (i.e., the Spielberger Trait Anxiety Inventory, the Liebowitz Social scale) or even recent and increasingly popular scales (e.g., the Social Thoughts and Beliefs Scale; Balon 2005).

Despite the popularity of questionnaires, they are limited to the questions that are asked, to the respondent's tendency to please the interviewer in a personal interview, or to be 'politically correct' in either the personal interview or in a paper/computer based interview. The tendency to comply with interviewer demands is well known in the psychological and social sciences literature (Rosenthal, 1976), and can lead to biased results, even when the respondent is not aware of such biases generated by the interview.

Stimulus-response methods and psychophysical thinking

A different way to look at issues of social policy can be implemented using methods originating from physics and chemistry, but taken over by experimental psychology. These methods go by the rubric of stimulus-response methods, and trace their origin to the philosophy of operationism wherein knowledge is defined as the ability to 'effect' a specific action by knowing what aspects of the antecedent conditions to change. The guiding principles are fairly straightforward, based upon the logic of experimentation. For social sciences the ingoing belief is that the key learning comes from the pattern of responses to test stimuli. If the respondent is presented with a series of test stimuli and the ratings to these stimuli obtained, then the relation between what the researcher presented and how the respondent scored the test stimuli provides the key information. The respondent need not even be aware of the criteria underlying his scoring. The regularity of such patterns and the ability to uncover the underlying relations between variables and responses is what constitutes the science.

The application of stimulus-response thinking to the world of social science can be traced back a century and a half to the seminal thinking of psychophysics, the first branch of experimental psychology, and the inspiration for the approaches discussed here. Psychophysics searches for orderly relations between what we perceive through our senses and the nature of the physical stimulus, usually the magnitude but often the quality of that stimulus. The goal of psychophysics is to develop relations between variables. It is these relations that generate the substance of our knowledge about how we perceive stimuli, and transform those stimuli into subjective responses. Psychophysics is informed by physics and chemistry, and especially by the search for 'rules' or at least for 'regularities' in nature (Boring, 1929; Fechner, 1960; Stevens, 1975).

How does psychophysics fit with social policy?

It is easy to trace the history of psychophysical thinking in the senses, and to identify how it evolved out of simple testing of differences to developing equations which show the change in perceptual intensity versus physical magnitude (e.g., changes in sweetness with increasing amounts of sugar). The psychophysicist studying the private world of sensory perception needed simply to change the amount of sugar in a water solution, creating thereby a number of test stimuli, present these solutions in some randomized order to a respondent, get a rating of 'sweetness' or 'liking', depending on the specific issues being addressed, and then plot the rating against the physical level of sugar. But what about social policy, where there is no intrinsic metric as we have for sugar (% concentration, molarity, molality)? In some unusual instances the social issue being studied has its own metric. For example, the degree of punishment for a crime can be quantified 'objectively' as the amount of the fine, the length of the prison term, etc. Psychophysicists working with these simple objective continua of intensity of punishment can correlate the rating of 'subjectively perceived seriousness' to the actual punishment. Such effort was all the rage 30-40 years ago (Wolfgang, 1973). For the more mundane problems, however, we need to use a different way of measuring responses, a way still consistent with the psychophysical way of thinking, but more appropriate to qualitative issues, such as the issue of terrorism, the focus of this paper.

Enter experimental design and conjoint analysis for 'attitudinal psychophysics'

At its very basic level psychophysics can be viewed as an application of experimental design as statisticians conceive of such a discipline (Box, Hunter & Hunter, 1978). Experimental

design refers to the systematic array of one or several variables in specific combinations, so that the research reveals how each of these variables behaves, and how they interact with each other. The psychophysical way of thinking conceives of these variables as physical stimuli that are mixed and matched. Psychophysics thinks, in turn, of the respondent as the device that integrates this information about the mixtures, comes up with a response, which is deconstructed by statistics to the contribution of the individual components.

Following this train of thought, let us move forward in our work on social policy using psychophysical thinking and experimental design. We recognize that in social policy research we typically do not have a well-behaved physical continuum, such as the concentration of sugar that we can vary, present to respondents, and secure ratings. Such physical continua are few and far between; the Wolfgang and Sellars continuum of physical punishment representing, therefore, a happy exception, rather than the rule.

However, what about treating social issues as simple, stand-alone phrases, that can be mixed and matched, presented to respondents, and ratings obtained? To some degree we've replicated the psychophysical approach and experimental design. That is, we have specific independent variables (the phrases), and a measured response (e.g., anxiety). Rather than seeing how the response changes with changes in one variable, we measure the contribution of each of the individual variables to the response, with these variables being statements that are either present or absent in the test stimulus. We have recreated a psychophysical design, albeit with the stimulus taking on the values '1' when present, or '0' when absent.

The application of psychophysical thinking and experimental design begins with the method of conjoint analysis, first introduced in the 1960's as a new method of measurement (Luce & Tukey, 1964), and later expanded to marketing issues (Green & Wind, 1973). The objective of conjoint analysis is to understand how components of mixtures act from responses to the mixture. These mixtures could be compound or complex physical stimuli, but they could just as easily be paragraphs comprising several sentences. The original methods used high-level, hard-to-implement procedures to determine the part-worth contributions or utilities of the components as they interacted in mixtures (Johnson, 1974). A parallel analytic direction by Norman Anderson (1970) used a simpler analysis of variance and decomposition methods to determine how these components acted. Even easier analyses using dummy variable modeling was proposed by Moskowitz and shown to be quite general in application (Box, Hunter & Hunter, 1978)

The basic approach of conjoint analysis and subsequent regression modeling can be summarized quite easily, and as we will see, this approach is eminently applicable to issues of public policy. Early approaches to public policy were demonstrated six years ago, using the technology of experimental design, decomposition analysis and subsequent modeling / optimization (Moskowitz, Gofman, Tungaturthy, Manchaiah & Cohen, 2000).

From a practical point of view the process is straightforward. The approach first identifies the raw materials to be studied, which in the case of public policy comprises relatively single-minded, stand-alone phrases dealing with the different facets of a social issue. These phrases are classified as belonging to different silos, or categories. The silo or category thus comprises like-minded elements or ideas, which may differ in what they convey. The elements are mixed and matched by experimental design to create combinations. The elements appeared independently of

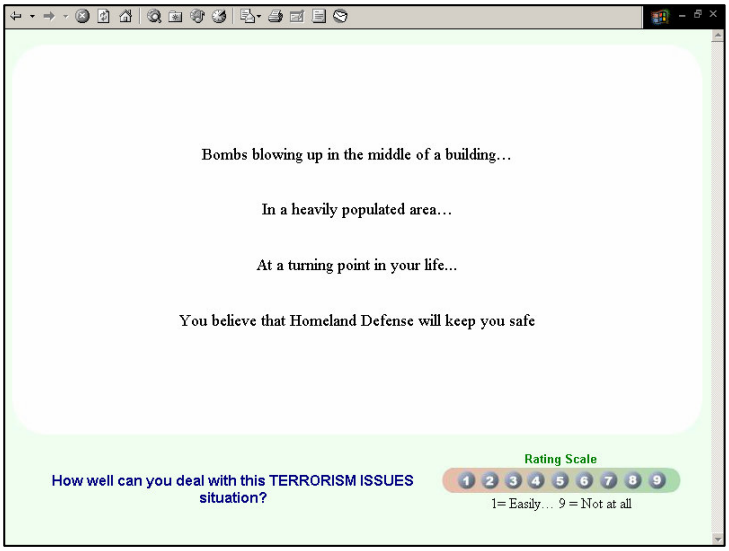

Figure 1: Example of a four element test concept. Each respondent evaluated 60 such sets, combining 36 elements into small vignettes. Every respondent evaluated a different set of combinations with the same elements.

each other in a statistical sense, although it's hard for a respondent to discern the underlying design. The respondent rates the combination, i.e., the test concept, on a scale. The ratings are then analyzed to show the number of scale points contributed by each component. Figure 1 shows an example of a four element concept.

Analyses – how & what do the data reveal using experimental design & self profiling?

Experimentally designed concepts provide a rich informational bed for data analysis. Recall that the original objective of the experimental design was to trace the relation between the respondent's rating and the presence/absence of specific statements about terrorism. This analysis is done quite easily at the statistical level. Basically, we know for each respondent what elements were present in each of the concepts, and we also know how the respondent reacted to that test combination. Regression analysis can relate the presence/absence of the 36 elements to the rating assigned by the respondent. To make the data easier to read, we have recoded the 1-9 scale to a 0-100 scale. The recoding does not change the relation between the scale points. A rating of '1' is recoded to '0', a rating of 5 is recoded to '50', and a rating of '9' is recoded to '100'. The remaining six points are similarly recoded. Such recoding maintains the equal distance between the adjacent scale points, but increases the size of the numbers so that they are easy to work with. Recoding the data and then running ordinary least squares regression generates the equation:

Rating = $k_0 + k_1$(Element #1) + k_2(Element #2) … k_{36}(Element #36)

The simple linear equation comprises 37 terms, each of which has meaning in a practical sense. The additive constant, k_0, represents the amount of 'anxiety' that occurs if there is no element present in the concept. Clearly the additive constant is a purely estimated parameter since all of the concepts comprised at least three statements, and most comprised four statements. However, one could use that baseline to look at differences among respondents. The utilities show the incremental (or decrement) percent of respondents who are 'anxious' when the element is present in the concept. The individual utilities, and the additive constant, have absolute values that can be data-based, and compared within a study across silos, across studies, and even across time and culture.

In Table 1, let's now look a little more closely at the utility values. The richness of the data allows us to look either within a group (e.g., total panel) across elements, or look within

the same silo or even the same element across the different subgroups. We will look at the highest utility in each of the four silos.

How psychophysical thinking has influenced the measurement of public opinion

Although public opinion research has a long and venerable history, we see from this paper that the psychophysical 'way of thinking' can make a new contribution to the field. Psychophysics seeks relations between variables, not only relations that are established by statistical analyses but also relations that are engineered by experimental design. In a sense, by importing and modifying psychophysics to public opinion research one may go from a descriptive science to an experimental science, at least when the experiments are conducted in cyberspace.

Table 1: Utility values for eight of the 36 elements by total panel, gender, and four age groups. Strong performing elements are highlighted.

		Gender		**Age**			
	Tot	Male	Fem	31-40	41-50	51-60	61-75
Base size	121	28	93	21	42	37	16
Additive constant	44	38	46	37	47	44	45
Silo #1 – Threats							
A bomb under your car…	**15**	**14**	**16**	**21**	**16**	**12**	**11**
A Computer virus let loose that impacts your everyday businesses…	-2	-1	-2	1	-4	-2	1
Silo #2 – Where the terrorism occurs or among whom							
An area crowded with children…	3	3	3	2	5	2	1
In a non populated area…	-2	-4	-1	-1	-2	-3	-1
Silo #3 – How you respond to the threat							
All the stress just builds up… you feel overwhelmed	3	1	3	5	3	3	0
You'd drive any distance to get away from it…	0	-3	1	1	-1	1	**-5**
Silo #4 – What might relieve the anxiety							
You believe that international cooperation in the United Nations will keep you safe	**13**	**21**	**11**	8	**11**	**19**	**16**
You trust that God will keep you safe	**-7**	4	**-10**	**-15**	**-9**	-1	-4

The key to switching from conventional questionnaires to experimental design is the realization that test concepts can be systematically created and then evaluated. Furthermore, the experimental design identifies the part-worth contributions of the components. The experimental design is simple and robust. The design allows for missing categories, which in turn allows for simplistic 'dummy variable regression'. In turn, this simple regression generates utility values that can be easily understood by the researcher as reflecting the

number of rating points that are added or subtracted to a baseline, after the nine-point scale is converted to a 0-100 point scale. The total response to the concept comes from summing the part-worth contributions of the components and then adding in the constant.

Such direct thinking about relations between variables is a hallmark of today's 'modern psychophysics'. The psychophysical methods, first developed by S.S. Stevens in the Harvard Dept. of Psychology, allow the respondent to act as a measuring instrument. Psychophysics comes in when there is an objective physical continuum against which these responses can be regressed, to develop a quantitative relation or 'model'. The key advance in the present paper is that the independent variables are not necessarily related to each other, but rather represent qualitatively different alternatives, so the relation is not between two variables (e.g., sweetness versus sugar concentration), but rather between one dependent variable (e.g., level of anxiety) and the presence/absence of the different qualitative variables (e.g., different statements or messages about terrorism acts, feelings, situations, and attempts at anxiety reduction). Despite the change in the nature of the model, from a continuous model to a discrete model, the psychophysical way of thinking still applies.

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