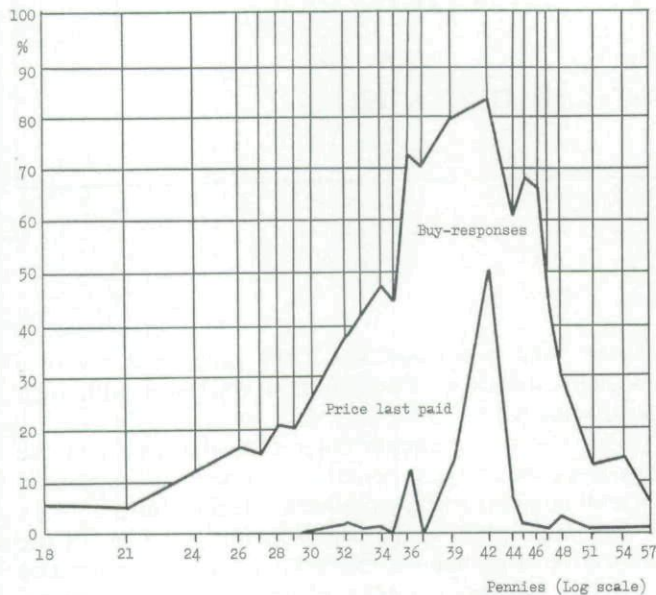PORK SAUSAGES

TOTAL SAMPLE: 1,518 HOUSEWIVES

Pennies (Log scale)

from negligible when the prices are high and will tend to enhance the importance of savings which result from switching to an Independent brand. Income effects will be less pronounced when gasoline prices are low.

While neither brand quality nor income effects have

anything to do with Weber's Law, they can well explain the observations of Kamen and Toman.

We conclude that quite apart from the conceptual inaccuracies on which we commented above Kamen and Toman have not presented appropriate evidence to support their contention.

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"Psychophysics of Prices": A Reaffirmation

JOSEPH M. KAMEN and ROBERT J. TOMAN*

Monroe and Gabor, Granger, and Sowter have raised a number of questions and reinterpretations of our article, "Psychophysics of Prices" [4]. We will show why our critics' statements are largely misleading or specious

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and why our original position is even stronger than that stated in the original article.

WHAT IS WEBER'S LAW?

Weber's Law states that the increment in stimulus intensity needed to produce a just noticeable difference (JND) is directly proportional to the stimulus. It has nothing per se to do with prices or price differences,

since any price difference is discriminable. However, it was clearly documented in the original article that extrapolations have been made based on this *directly* proportional relationship. Berelson and Steiner [1, p. 97], Miller [5], and Webb [7] are among the many others who have stated the applicability of Weber's Law to consumers' reactions to prices. To our knowledge, no one has ever extrapolated from Weber's Law that reactions to price differences should not be directly proportional to price levels.

We, on the contrary, hypothesized that under certain conditions, the price differences would bear an *inverse* relationship to price, particularly where price exceeds a "fair" level. *There simply is no JND for price,* and our methodology shows we were testing not discrimination, but preference behavior.

We do believe that this extrapolation is generally correct, but we wanted to investigate specific conditions under which it would *not* be valid. If one accepts this clarification, as Gabor *et al.* do, then Monroe's equations are entirely superfluous. He ignores the fact that we dealt with preference rather than with discrimination when he posits individuals who do not perceive a price difference. A necessary condition in our study was that persons *do* notice every price difference, and our questionnaires were expressly designed to focus their attention on this fact.

In his discussion of price as an indication of cost, Monroe assumes that *all* individuals who perceive a price difference will choose the lower priced item. Similarly, with regard to price as an indication of quality, he assumes that *all* individuals will choose the higher priced item. Our data clearly show that neither assumption is tenable.

PRICE-QUALITY RELATIONSHIPS

Both critics state that if the price of gasoline becomes abnormally low, motorists would doubt the quality of Independents more than that of Majors. The critics imply that Independents, not particularly strong on perceived product quality even at normal prices, would have less to lose by marketing an inferior product. We believe this hypothesis is insufficient to explain our findings.

First, the effects of price level were largely linear and extended throughout the entire range of prices used (e.g., the figure), even well above normal prices.

Second, declines in Majors' market shares are manifested almost instantaneously when prices are restored following a price war, as a recent intensive study has shown. Do motorists believe that a sudden upward price movement immediately induces Independents to dispose of the gasoline in their storage tanks and refill with a higher quality product?

Third, we had referred to a concurrent study of ours where motorists evaluated first and second choice brands, instead of Majors and Independents; typically, both were Majors. The effects here seemed *even more*

pronounced: the second choice was, in fact, often perceived as being superior. Indeed, quality was far less a discriminator between first and second choices than was service and convenience, but our data showed that as price levels rise, even though the differential remains the same, consumers seem ready to sacrifice these to revert to a "fairer" price level.

Consistent with the "fair price" formulation, this evidence points to lesser effectiveness of tangential benefits, features, and services during periods of increasing prices. From the research cited by our critics and from our own observations, we do not doubt that consumers often relate price to quality; but we believe that the requisite conditions for such a relationship were *not* operating here.

ALTERNATE THEORIES

To set Gabor *et al.* at ease, we do not accept our theory as *the* theory. First, a "crucial-test" theory would be premature, since it cannot be very precisely formulated. Second, we phrased our theory to be readily understood by management responsible for pricing decisions. Third, the title was suggested by consumers to whom we talked.

More importantly, the same predictions can be made from many theories differing in assumption structure and levels of aggregation. The fact that the data support one theory should not be an affront to the proponents of another, and a psychologically-based theory should not be considered inferior to a compatible one grounded, say, in microeconomics.

There is no dearth of alternate and supplemental theories.[1] But this article was not intended to be a comprehensive review of theory and research in this area. The fact remains that our theoretical statement is simpler, makes more sense, and leads more directly to actionable alternatives.

ON LOGARITHMIC FUNCTIONS

And Weber's Law

Weber's Law and the Fechner Law are highly related, as Monroe has pointed out, and both yield the inference that a constant price difference should be less important

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[1] One could use approach-avoidance gradients [4, pp. 289–91] to explain the results. Our follow-through study data lend themselves to such an analysis. Or one could speculate that motorists who believe Majors are responsible for rising prices would shift to Independents to force the Majors' price reduction. This explanation combines elements of reinforcement and frustration-aggression theories and Marxist ideology. Or one could hypothesize that rising prices induce psychological trauma and subsequent regression to a lower psychosexual stage, e.g., to the oral-sucking stage where the motorist increases his love of himself relative to his Major brand dealer for whom his patronage reflects affection. Or he might regress to the anal stage, a characteristic of which is miserliness.

Table 1

DISTRIBUTION OF PERCEIVED FAIR PRICES, INCLUDING TAXES, FOR GASOLINE (1964 STUDY)

Price (cents)	Number of users	
	Regular grade	Premium grade
Less than 16	3	0
19	1	0
20	2	2
21	1	0
22	2	0
23	1	0
24	5	0
25	33	8
26	10	2
27	10	3
28	33	8
29	23	3
30	20	19
31	3	5
32	2	6
33	0	2
34	0	3
35	0	5

the higher the absolute price. Sowter *et al.* say, in their theory, that the brand preference function depends only on the difference between the two log prices [6, p. 226]; and the larger the difference the greater the probability of buying the lower priced brand. Hence, for any constant price differential, the difference between the two log prices at a low price level is psychologically greater than at a high price level. Therefore, more people should prefer the higher priced brand when the price level is high, an inference that is consistent with what could be expected from Weber's Law. But as we have shown, our data are incongruent with this prediction.[2]

And Psychological Truths

Both critics make misleading and irrelevant statements implying the existence of a fundamental psychological price law akin to the Fechner Law. Have they considered the simpler alternative that many items *in the marketplace* are logarithmically priced and that consumers' subjective perceptions parallel reality?

Gasoline is not an item for which the actual price distributions are positively skewed and can be normalized by log transformations. The top price is likely to be close to the mode, but mavericks can price well below it. The following is a distribution of one day's pump prices for regular grade gasoline among 278 service stations in a typical market:

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[2] There is also a conceptual difference between a log-normal distribution of acceptable prices and the log function relating actual prices to subjective prices, and between functions derived for groups vs. individuals.

Price (cents)	Number of stations
25.9	2
26.9	0
27.9	9
28.9	15
29.9	57
30.9	33
31.9	135
32.9	25
33.9	0
34.9	1
35.9	0
36.9	1

Is there evidence of positive skewness? No. Table 1 presents the distribution of motorists' "fair" prices, from the pilot study reported in the original article. Again, note the absence of positive skewness.

The figure plots mean rating as a function of price level at various Major-Independent differentials. Is there even a suggestion of a logarithmic function? Is not a linear function reasonable?

METHODOLOGY

Price Levels Used

Gabor *et al.* claim that the prices we used (as low as 15¢ in the pilot study) were unrealistic and could have distorted the results. We purposely went to extremes because we wanted to see the range of validity for our theory. We had expected it to break down at the very low and the very high levels, but as the figure illustrates, it did not. In particular, we believed that the operation of Weber's Law would be manifested at 40 cents, but the evidence was to the contrary. We are happy we tested limits in our pilot study, since it gave us a better basis for specifying the range of prices and the models used in the follow-through study.

Stimulus Specification

Monroe questions our asking motorists to choose their own specific Major and Independent brands. Because these differed among motorists, he concludes that no real stimulus exists, and that we really studied three (pilot study) or four (follow-through study) variables, one of which was brand image.

Majors and Independents constitute *populations* of stimuli and in this sense are generic stimuli. Motorists, in effect, draw the samples from populations which are more likely to be representative of these populations than if researchers specified one or some other arbitrary number. Thousands of interviews showed that brands are not equally known within a given market. Also, asking a motorist to rate an unfamiliar brand would also require an assumption we were not willing to make: that the actual distribution of specific brands within a market corresponds to motorists' psychological distribution, regardless of whether or not we weight brands by their representation or volume.

By having a motorist choose his own brands, we most

realistically simulate a psychologically dominant Major directly compared to a psychologically dominant Independent, giving full play to individual differences in brand dominance.

In the follow-through study, we analyzed the data according to certain individual brands of particular interest to us, including Standard. The results of the analyses clearly supported the conclusions derived from analyses in which we pooled brands.

MEAN RATINGS AS A FUNCTION OF PRICE LEVEL: REGULAR GASOLINE USERS

PRICE OF INDEPENDENT BRAND GASOLINE, IN CENTS
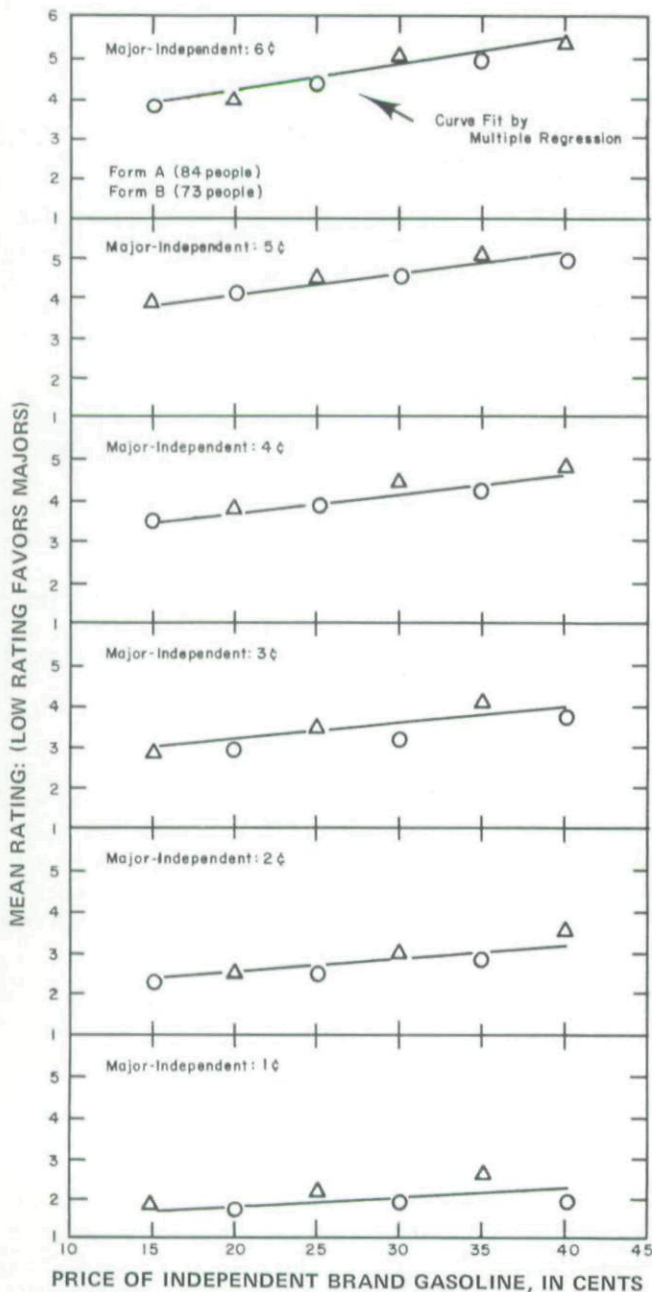
Monroe's comments about brand images reflect some epistemological naivete. Monroe ignores the fact that the same brands do have different images in different markets and that clear intrabrand heterogeneity even exists within the same market. It is legitimate to specify our stimuli at any level of generality consistent with our research objectives—brand type, specific brand, specific brand in specific market, specific brand in specific station, etc. We specified the population of brands to motorists, and they sampled from this population.[3]

Universality of Motorist Reaction

Monroe restates the fact that a sizable proportion of motorists indicated they would buy only one brand regardless of price, speculating that perhaps brand influence completely dominated the price variables. Our highly statistically significant price effects belie this supposition.

No one would hypothesize that all motorists would respond in the same way. We merely hypothesized that switching to Independents as price levels increased was more salient than switching to Majors. We know that motorists can take many other courses of action, a common one being doing nothing. Table 2 shows the actions of 3,600 motorists in reaction to gasoline price increases.

As another example of lack of universality, some people prefer to buy the highest priced brand if thereby they get more trading stamps, and particularly if their employers pay the bill.

MULTIPLE REGRESSION

Monroe's Complaints

Monroe complains that a sufficiently large number of variables gives a high R^2 and that without a rationale for considering these functional relationships, the analysis can only be considered a statistical exercise with little theoretical function.

One answer is implied in the figure and a following section on response functions. Another requires a deeper understanding of the use of multiple regression in experimental designs, a topic that is thoroughly discussed in a book co-authored by Toman [2].

Monroe's concern about capitalizing on chance is totally unfounded. Considering the broad range of gasoline prices investigated and the very complicated models that might have been used, it should be a source of comfort that smooth, symmetric quadratic response surfaces summarized the results adequately.

Only two simpler models were possible in the pilot study, the overall mean rating alone and linear price variables without the quadratic terms. The former is the

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[3] Analogously, if we have husbands rate their wives on some characteristics and then aggregate the ratings, we can make inferences about husbands' perceptions of wives even though each wife is different. It is not necessary to rotate a specific conjugal bed.

Table 2

MOTORISTS' ACTIONS TO REDUCE COSTS: IN ORDER OF SALIENCE

Course of action	Yes	No	Partly	Don't know/ other
Combined several errands per trip	34.1	62.2	2.0	1.7
Tuned engine mainly to save gasoline costs	26.6	69.3	2.2	1.9
Used the more economical car more often[a]	23.1	75.2	0.9	0.8
Thought of buying a car which is less expensive to operate	22.7	75.8	1.4	0.1
More careful in driving—lower speeds or fewer fast starts and stops	21.4	77.1	1.3	0.2
Bought different gasoline grades	13.7	84.3	1.8	0.2
Changed service stations	13.0	84.8	2.0	0.2
Cut down on short pleasure trips	7.7	91.4	0.8	0.1
Cut down on the one-day or weekend trips of 100 miles or longer	7.2	92.0	0.5	0.3
Did anything else to cut down gasoline costs[b]	5.6	92.2	0.2	2.0
Cut down on vacation travel	4.5	94.8	0.5	0.2
Joined or formed a car pool	4.2	95.3	0.4	0.1
Used public transportation more often	2.1	97.6	0.2	0.1

[a] 39.1% of the households had more than one car.

[b] Includes such methods as walking, using motor scooter, etc.

degenerate case indicating complete insensitivity to prices. Linear price effects only over the range of prices were considered unrealistic since human behavior is rarely that simple.

In short, there is not a more parsimonious model that we could have reasonably used. Parallel considerations obtain in the follow-through study.

Allegations by Gabor et al.

Gabor et al. note that when we moved from Model I to the simpler Model II by removing two significant variables, there were no changes in the estimated coefficients of price-squared and differential-squared. They feel that such a result is unlikely. A more proper question concerns the confounding patterns between the two price variables and the form variable.

The 36 price combinations were divided into two sets of 18 in two questionnaire forms. The allocation of prices to the two forms was planned to avoid confounding them with quadratic price variables even though the forms were aliased with linear price effects. Therefore, in moving from Model I to Model II, which eliminated the effects of the questionnaire forms, the coefficients on the quadratic price variables cannot be affected. The coefficients on the linear price variables change because

they are aliased with the form. The confounding relationships for the quadratic of price-squared are:

$$P^2 - .09FD - .23FD^3 - .46FD^5 - 1.52FPD^3$$
$$- 3.05FDP^5 - .81FP^3D - 4.32FP^3D^5 + .95FP^5D$$
$$+ 2.54FP^5D^2 + 5.08FP^5D^5$$

where: P is price level, D is price differential, and F is form. The coefficients for the quadratic terms (FD^2, FP^2) are zero, which can easily be demonstrated for D^2 as well. Hence F has no effect on coefficients for P^2 and D^2. We studied the confounding relationships for all 35 price variables, including interactions, before specifying the models.

THE NATURE OF PRICE SENSITIVITY

Gabor, et al. state that we "do not seem to be aware of the fact that . . . consumers' behavior can be subject to abrupt changes when certain limits are approached." Our notion of "fair price" shows that we were, but our evidence did not support this "fact." When we plotted, for individuals, ratings around their "fair price" levels in the pilot study, we found no points of inflection which we would expect if changes were abrupt. Linear relationships were generally found, even for "unrealistic" prices.

Because of the limited number of price combinations evaluated by respondents, we hypothesized that the point of inflection may have been obscured, so the follow-through study used a center-composite design to detect such a point. This design concentrated observations around the modal fair price levels. Again, we failed to find any abrupt changes.

Perhaps our measuring instruments were too unreliable on an individual basis, or perhaps the concept of "fair price" should be modified to connote a continuous rather than a discrete entity.

Our range extended beyond typicality (for 1964) but perhaps it was yet insufficiently broad that linearity still predominated. We had expected that at the very high prices, effects anticipated from the "fair price" theory would be tempered by those from extrapolations from Weber's Law, but we did not succeed in reaching that level. We have to agree with the proponents of Weber's Law that, for example, at $2.43 per gallon the effects of a one-cent differential would be immeasurable.

ALTERNATE PREDICTIONS

Although studies of price sensitivity are not new, no one has juxtaposed this concept with extrapolations from Weber's Law, which yield a prediction contrary to that from a sensitivity orientation. In practice, decision makers do consider the two conflicting theories. It can also be shown that Gabor, Granger and Sowter can arrive at two different predictions depending on which of their articles one reads.

Our research has highlighted the need for revising

some conventional theorizing about price behavior, particularly by those who say they could have predicted anything, but after the fact.

While our theory is far from precise, we did demonstrate the diverse implications for applications and further research.

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