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An experimental inquiry into the effects of parameters of price structure on buyers' price judgments.

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AN EXPERIMENTAL INQUIRY INTO THE EFFECTS OF PARAMETERS OF PRICE STRUCTURE ON BUYERS' PRICE JUDGMENTS

A Dissertation Presented

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(April 1975)

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ABSTRACT

This dissertation investigates how buyers evaluate prices of products and develops models to predict buyers' judgments of various sets of prices. The research strategy is to study price as a stimulus by using the psychological concept of adaptation level. Adaptation level is the implicit frame of reference for stimuli judgment, and a stimulus at the adaptation level is judged "medium."

Based on the Helson and Parducci theories of adaptation-level, three parameters of a price set -- the geometric mean, the midpoint, and the median -- are varied to determine their effects on adaptation-level price which is the price judged "medium." (The geometric mean of n prices is the n^{th} root of the product of the prices; the midpoint is the average of the highest and the lowest prices.) Sets of prices for ball-point pens, alarm clocks and bicycles are studied under laboratory conditions. Subjects for the entire study are 285 undergraduates who are required to first examine sets of prices for each product and then sort them into judgmental categories.

The research hypotheses are that increasing each price parameter increases the adaptation-level price, if the other parameters are held constant. Each price parameter assumes "low" and "high" treatment levels in separate completely randomized designs. ANOVA and t tests show that increasing the geometric mean significantly increases the adaptation-level price for all three product classifications; the midpoint's effect is reversed for pens and clocks and not statistically significant for any product category; the median's effect is directionally supported in all cases but significant only for clocks. Thus, Helson's model of judgment, which includes the geometric mean, is supported by the data, but Parducci's model, which includes the midpoint and median, is not. The findings suggest that, in spite of previous purchase experience and knowledge of prices, buyers do not always make absolute price judgments, and what they consider a "medium" price may shift depending on the prevailing structure of prices.

Multiple regression techniques are employed to predict individual adaptation-level prices by using a logarithmic relationship. Regressors include the price parameters, the highest and the lowest prices, and the "expected price" (a measure which taps the buyer's previous knowledge and future expectations of the prices of the product). The geometric mean price and the expected price emerge as the most important significant predictors for all three product categories. Proportion of variance explained range from 0.20 to 0.41. An alternative linear model in which the geometric mean is replaced by the arithmetic mean produces similar results for pens and clocks and an improved data fit for bicycles.

Validations of the estimated equations are made by using the equations to predict the adaptation-level prices of a separate subgroup of subjects who evaluated real market prices. Predictions are quite good for bicycle prices, reasonably good for pen prices, and fair for clock prices.

Significance of the findings are discussed for theory and research in price perception and buyer information processing. This study strongly confirms that adaptation level is a suitable theoretical framework for pricing research. Managerial implications are suggested by demonstrating how to attempt to predict buyers' responses to different price structures that may arise from a variety of pricing situations. Additionally, public policy implications are suggested in the area of price regulation and consumer protection.

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CHAPTER I

PRICE IN A STIMULUS-RESPONSE FRAMEWORK

Introduction

One piece of information or cue that ordinarily is available to a buyer is the price of the product. How the buyer perceives or derives meaning from this information is not yet well understood. The micro-economic theory of consumer behavior has traditionally assumed that the role of price in a purchase decision is to indicate the cost or financial sacrifice to the buyer. Recent research reveals, however, that a buyer's subjective perception and judgment of a given price may also involve considerations of product quality, the last price paid, the range of prices for similar alternatives, the lowest alternative price, the highest alternative price, conscious concern or awareness of prices, and the frame of reference for evaluating the alternative product offers [15,17].

Other cues such as brand image, package features and labeling, market share, and store image also affect a buyer's decision. Researchers have yet to combine all of these variables into a complete buyer information-processing model. Since there is no realistic explanation of how the buyer uses the single cue, price, it is suggested that more fundamental pricing research is needed before more complex behavioral theories for multicue situations can be developed.

Price as a stimulus. An assumption in this dissertation is that price can be studied as a stimulus in the tradition of psychophysics. Psychophysics is the branch of psychology concerned with the quantitative relationship between physical stimuli and the psychological responses they elicit [9].

A direct application in pricing research was the study of price thresholds. Research in the U.S.A. and in Europe suggests that for any given product there is an upper price beyond which a buyer considers the product too expensive to purchase, and a lower price below which the product is suspected to be of inferior quality and again no purchase is made [15]. These upper and lower prices (statistically determined) are called absolute price thresholds and together define a range of acceptable prices called the latitude of acceptance.

There is limited evidence on the perception of price differences. The data indicate that sensitivity to price changes is different for price increases as compared to price decreases, and in some cases a price change (either way) is not perceived at all. The concept of differential thresholds is useful for describing these perceptual phenomena. It is the minimum amount of change in a stimulus (price) necessary to produce "just noticeable difference" or JND. The effects of differential threshold are important in marking down prices of products (sale pricing).

Overview of this chapter. The major purpose of this dissertation is to investigate and model how buyers judge a set of prices for a given product. Two psychological concepts appear to be particularly useful in conducting this research -- adaptation-level and assimilation-contrast. The basic theories and selected research involving these concepts will be presented in the major part of this chapter. Then the relatively few efforts by marketing researchers to apply the concepts to pricing will be reviewed, followed by an identification of some unresolved research problems.

Adaptation-Level Theory

In 1938, Helson introduced the concept of adaptation level (AL)[1] to explain the phenomena of constancy, contrast, and color conversion in the field of vision [12]. Later the AL concept was extended as a frame of reference for the prediction of psychophysical data in other areas of psychology. Since that time, Helson and his co-workers have performed and reported numerous studies designed to investigate the various factors that affect AL and its related functions. The comprehensive theory and supporting data were published in 1964 in a landmark book: Adaptation-Level Theory: An Experimental and Systematic Approach to Behavior [10].

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[1]From now on when so used "AL" stands for "adaptation level."

A statement of adaptation-level theory. The fundamental proposition of adaptation-level theory is that, in any behavioral situation, an individual responds to the pooled effect of three classes of stimuli -- focal, contextual, and residual. The pooled effect is the adaptation level which is a frame of reference to which the response is relative. The focal stimuli are those stimuli to which the organism is directly responding and which are in the immediate focus of attention. The background stimuli are all other stimuli that are present in the behavioral situation and that provide the background or context within which the focal stimuli are operative. The third class of stimuli relate to the internal state of the organism and are called residual stimuli. These are all the determinants of behavior which are ordinarily not under experimental control but which characterize the specific organism and include the effects of past experience, underlying organic and physiological states and constitutional factors.

Adaptation level may be quantitatively specified by giving a value of stimulus eliciting the neutral response from the organism, or bringing forth responses that are neutral, doubtful, medium, or the like. Stimuli above AL produce a response of one kind such as "high," while stimuli below AL elicit responses of the opposite kind such as "low." It should be noted that AL denotes a region rather than a point on the stimulus continuum, although it is commonly represented by a single value.

Quantitative formulation of AL theory. In mathematical terms, the behavioral adaptation level is defined as a weighted product of the three classes of stimuli -- focal stimuli, contextual or background stimuli, and residual stimuli. Specifically,

$$A = K \cdot \overline{X}^{p} \cdot B^{q} \cdot R^{r} \tag{1-1}$$

or, in logarithmic form:

$$\log A = \log K + p \log \overline{X} + q \log B + r \log R \tag{1-2}$$

where A is the adaptation level;

$\overline{X}$ is the geometric mean of the focal stimuli;

B is the background stimulus or the geometric mean of the background stimuli if there are more than one;

R is the residual stimulus;

K is an empirical constant;

and p,q,r are weighting coefficients.

The relative importance of the contributions of the three classes of stimuli to AL are given by the weighting coefficients which may be normalized by setting their sum equal to unity. That is:

$$p + q + r = 1 \tag{1-3}$$

Helson gave several reasons for using the weighted logarithmic mean (or weighted geometric mean) to define AL [10, p. 60]:

1. The values predicted by the weighted logarithmic mean are in closer agreement with experimentally obtained values of AL than those provided by any other a priori value under a variety of conditions.

2. The log mean is affected by both range and density of a set of values, something that is not true of the arithmetic mean or the median when the stimuli distribution is symmetrical.[2]

3. The log mean increases less rapidly than does the arithmetic mean as larger and larger values of the stimuli are added to the experimental setup; this more adequately represents the gradual shift in AL which occurs when extreme stimuli are introduced. Thus, the log mean automatically incorporates the law of diminishing returns which, while not universally true, is a good first approximation to the relation between stimulus intensity and magnitude of sensation or response (Fechner's law).

Other definitions of AL have been found to be appropriate for certain situations. For example, Parducci and his coworkers have found that the median stimulus and the midpoint stimulus (mean of the highest and lowest) are useful in defining AL [21]. Parducci argued that for certain stimuli, such as magnitude of pure numerals, it is not necessary to assume a logarithmic response (use of geometric mean for AL), since discrimination or judgment should be of equal difficulty over the entire range of the stimuli presented. This suggests that AL may be predicted well by the arithmetic mean of the stimuli as opposed to the geometric mean.

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[2] The geometric mean (log mean) of n numbers is the n^{th} root of the product of the numbers; the arithmetic mean is the simple average of the numbers; the median is the middle number in ascending or descending order.

In the Parducci et al. experiment, groups of college and secondary school students were presented with different distributions of numerals occurring between 108 and 992. Each subject was instructed to study the entire list of numbers on a single 8-1/2 x 11 -inch page before rating each number on a 5-point scale from "very small" through "medium" to "very large." The dependent variable was AL which was defined as the arithmetic mean of the stimuli each subject had judged medium. The major independent variables were the mean, the midpoint (mean of the two end values) and the median of the stimuli. It was found that shifts in AL (and therefore shifts in judgment) were associated with shifts in either the midpoint or the median -- even though the mean was held constant. The mean itself appeared to have little effect on judgment when the mid-point and median were held constant. A regression equation relating mean group AL to the mid-point, median and range was obtained, but the contribution by the range was not statistically significant. The equation was: AL = 0.547 (midpoint) + 0.450 (median) - 0.027 (range).

The researchers interpreted their data as consistent with the proposal that the judgment scale reflects a compromise between two different tendencies: (a) to divide the range into proportionate subranges, and (b) to use the alternative categories of judgment with proportionate frequencies. Thus, if the subject were allowed only two categories, the first tendency would make him want to divide the stimuli at the midpoint (half way between the lowest and highest), and the second tendency would make him divide the stimuli at the median of the distribution.

Later, Parducci and Marshall varied the method of presenting the numerals [20]. Instead of having all the numerals on a page, a list of 44 numerals was read aloud three times to the subjects before the numbers were read singly in random order for judgment. With AL defined as the mean of the numberals judged medium, they obtained good predictions of AL values from a regression equation relating AL to the midpoint, median, and range obtained in the 1960 study. In yet another study, Parducci and Marshall used length of lines as stimuli instead of numerals [19]. A six-point rating scale was used and AL was defined as the midpoint between the longest line judged "3" and the shortest line judged "4" (i.e. the arithmetic mean of these two lengths). Again they found AL, as defined, to vary systematically with variation in either the midpoint or median but not with the mean. Two regression equations each relating AL to the midpoint and median were obtained for two different spacings of the lines.

On the whole, Parducci and his co-workers found strong evidence that AL could be expressed as a linear combination of the median and midpoint of a set of stimuli especially when the stimuli are exposed together. Since the midpoint was defined as the arithmetic mean of the largest and smallest stimuli values, it suggests that the two end stimuli are weighted more heavily than the rest of the stimuli in determining the AL.

Psychophysical scaling. The fundamental concern of psychophysics is to relate psychological response measures to the physical stimuli producing them. The overt responses are usually in the form of judgments, so in practice, judgmental scales are related to stimuli scales. Since the value of adaptation level merely fixes a point or narrow region on the stimulus continuum, exact prediction of all responses must be determined by means of stimulus-response functions covering the whole continuum. The shape of the stimulus-judgment curve depends upon many factors such as the stimuli being judged, the experimental task, the psychophysical method, the method of data analysis, and the position of AL.

Two response functions embodying AL have been derived, one by Helson [11], and the other by Michels and Helson [14]. Both functions yield negatively accelerated curves since changes in magnitude of "small" stimuli give rise to greater changes in judgment than do equal changes in larger stimuli. Such curves may be made linear by taking the logarithms of the stimuli. These curves show spreading of judgments at the low end of the stimulus range and assimilation or compression at the high end. The two functions have been found especially applicable to data obtained from both absolute and comparative rating scale methods. Only the function by

Michels and Helson will be sketched here, because it represents an improvement over Helson's earlier effort, and it is associated with the well known Fechner law. The classical Fechner law states that:

$$R = K \log \frac{S}{S_o} \qquad (1\text{-}4)$$

where R is the magnitude of sensation evoked by the stimulus S, and S_o is the stimulus at absolute threshold. In the reformulated law, the absolute threshold is replaced by AL as the origin with respect to which judgments are made.

In deriving the reformulated Fechner law, Michels and Helson made five assumptions [14, p. 357]:

1. The Weber law[3] is valid within sufficiently broad limits to be applicable.

2. The judgment "neutral" or "medium" belongs to the stimulus X = A, where A is the adaptation level.

3. The judgment scale and the stimuli encountered are equivalent in the sense that the scale is broad enough to include judgments of all the stimuli encountered and yet is so narrow that its extreme values do not fall outside the range of judgments elicited by any of the stimuli.

4. When an observer adjusts his responses to a series of 2N + 1 categories (2N steps), symmetrically placed about "neutral," he does so by choosing as the first step below "neutral" the response corresponding to a stimulus of intensity (1-1/N).A. In other words, he responds as if he had divided the stimulus A into N equal parts and had used all but one of these for his first step below "neutral".

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[3]Weber's Law states that the increment in stimulus intensity needed to produce a just noticeable difference (JND) is directly proportional to the stimulus.

5. In forming his judgments, the observer can make comparisons only in terms of the judgment scale. This means that all subsequent steps will have the same size on the judgment-scale as the first step and that the adaptation level will be determined by a mean of judgment rather than by a mean of stimuli.

Using the above assumptions, Helson and Michels showed that in a series stimuli, X_i, the judgments, J_i, are related to the stimuli by [14, p. 361]:

$$J_i = C + K'\log (X_i/A) \qquad (1\text{-}5)$$

or

$$J_i = (C - K'\log A) + K'\log X_i \qquad (1\text{-}6)$$

Where: A is the observable adaptation level of the stimulus series;

J_i is the linear rating scale value corresponding to stimulus value X_i, $J = 1,2,\ldots,2N+1$;

N is the number of judgmental categories on either side of the middle category of the scale;

$C = N + 1$, and is the middle of the rating scale, i.e., the neutral judgment elicited when $X = A$;

K' is the observable slope in equation (1-5) or (1-6), and is related to the number N used in constructing the scale.

In a least squares regression of J versus log X (equation (1-6)) the intercept is C - K' log A and the slope is K'. With C and K' known, the adaptation level, A, is determined. (Note that in a 7-point rating scale, C = 4 and N = 3.) The above equations allow the determination of adaptation level by using all the data instead of by merely taking the mean of the stimuli judged medium or neutral.

Assimilation-contrast effects. On the basis of data obtained from a study involving lifting small weights, it has been suggested by Sherif, Taub, and Hovland that the two processes at work in psychophysical judgments are contrast and assimilation, which are manifested in opposite effects [25]. Displacement of judgments of a series of stimuli toward the judgment of an anchor (stimulus used momentarily as a reference) is a manifestation of assimilation, while displacement of judgments away from judgment of the anchor is a manifestation of contrast. Sherif et al. summarized their results thus [25, p. 150]:

> When an anchor is introduced at the end or slightly removed from the end of the series, there will be a displacement of the scale of judgment toward the anchor and assimilation of the new reference point in the series. When, however, the reference point is too remote there will be displacement in the opposite direction (i.e. away from the anchor), with a constriction of the scale to a narrower range.

They also noted that assimilation is not easily explained in terms of the adaptation-level approach.

Nevertheless, Parducci and Marshall replicated the Sherif et al. study with additional checks and concluded that assimilation and contrast effects are consistent with AL theory, since those effects could be explained as due to shifts in AL [18]. For example, they showed that when an anchor was designated near the top end of the weight series, AL was reduced from its former level without anchor, leading to higher categories of judgment (an assimilation, since the higher categories are similar to the judgment of the anchor); when the anchor was much higher than the rest of the stimuli, AL was increased, leading to lower categories of judgment (a constrast, since the lower categories are opposite to the judgment of the anchor).

Application of Adaptation-Level Theory to Pricing

Emery was one of the first researchers to note the implications of these physchological principles on price perception [5]. Emery hypothesized that there appears to be a "normal" or standard price for each discernible quality level in each product class, and this normal price tends to act as an anchor for judgment of individual prices. Furthermore, the normal price or standard will tend to be some average of the prices being charged for similar products, and need not correspond with the price of the leading brand nor any other actual price.

Following Helson, these standard prices might be called adaptation levels. Various researchers have referred to the standard price as "normal price," "fair price," "traditional price," each implying that the buyer uses it as a reference for judgment. To apply Helson's equation (1-1) in a pricing context, AL is defined as a weighted logarithmic mean of the focal, contextual and residual prices. We shall call prevailing prices the focal prices (such as for a set of brands of a product on the retail shelf), the contextual or comparison price will be labeled anchor price, since prices are not directly comparable in the psychophysical sense of a standard versus a variable stimulus, and the residual price will be called standard price.

$$A = K.\bar{P}^p . B^b . S^s \tag{1-7}$$

or $$\log A = \log K + p \log \bar{P} + b \log B + s \log S \tag{1-8}$$

where:

A is the adaptation-level price resulting from a given configuration;

$\bar{P}$ is the geometric mean of the prevailing prices;

B is the anchor price;

S is the standard or "normal" price;

K is an empirical constant;

p, b, s are weighting coefficients normalized so that

$$p + b + s = 1 \tag{1-9}$$

In a shopping situation no anchor price is ordinarily explicitly introduced, so we eliminate that variable in equation (1-7). Further, for products that are not purchased often, a buyer may not have a firm idea of what the normal or standard price should be. If that variable is also eliminated in equation (1-7), in theory the geometric mean will be the major determiner of AL.

To adapt the ideas of Parducci [21] regarding the effects of the midpoint and the median stimuli in a set, then it would be suggested that the high and low prices, as well as the middle price, on the retail shelf may be more noticeable to a buyer and thereby affect his judgment. That is, these prices may make a buyer perceive a given alternative brand as being a bargain or as being too expensive, depending on where its price lies in the price range.

Evidence of standard price. There is some indirect evidence in the pricing literature supporting the hypothesis of a standard price serving as an AL for price judgments. In his review of the relationship between price and quality of a product, Shapiro [22] hypothesized that once the price of a product has been established in the consumer's mind, even in the form of a price range, that price will become the "fair" or normal price. If the product's price is then raised without perceptible changes in the offer, the consumer is not likely to impute higher quality to the product. Gabor and Granger [6,7,8] conducted surveys of large samples of housewives and obtained lower and upper acceptable price limits and price last paid for certain products. Their results suggest that a buyer is most likely to purchase if the products' price falls within an acceptable price range whose limits are related to prevailing market prices and the price of the product normally purchased. Gabor and Granger derived bell-shaped buy-response curves showing the proportion of consumers who said they would buy at each of the specified prices. In particular, the buy-response curves for consumers who reported that they last paid a particular price peaked at that price, as expected. Assuming that the price last paid in most circumstances will approximate the price normally paid or the standard price, the evidence indicates that the probability of purchase is highest at the standard price.

In describing the results of his experiments relating price to product attractiveness, Olander [16] indicated that from a small pilot study he had obtained data suggesting that a buyer's price judgment is influenced by his perception of prevailing market prices and by what he thinks is the price most frequently charged.

Kamen and Toman [13] proposed and tested a "fair price" theory, "according to which consumers have some preconceived ideas about what is a fair price for a given item, and are willing to pay this price or below." From the results of a survey of motorists' reactions to price differences between independent and major gasoline brands, Kamen and Toman asserted that their theory was supported.

Alexis *et al*. [1] examined the relationship between price and product characteristics for five frequently purchased articles of women's clothing. From a field study and follow-up experiment involving housewives they noted that a consumer goes shopping with a "target" price in mind around which there is an acceptable deviation.

Doob and his co-workers [3] performed five field experiments using mouthwash, toothpaste, aluminum foil, light bulbs, and cookies. For each product a new brand was introduced at a "low introductory" price in one set of stores, while in a matched set of stores the brand was introduced at the normal selling price. After a short period of time varying from one to three weeks, the low introductory price was raised to the normal selling price. Sales were monitored in both sets of stores during the entire experimental period. The tested hypothesis was that the low introductory price would initially produce more sales than the control condition, but that after the low price had been raised to the normal price, sales would become higher for the control condition. The researchers found strong support for their hypothesis.

In explaining the results of the study, Doob et al. cited cognitive dissonance theory, but they also suggested adaptation level as an alternative explanation [3, p. 350]:

> "When mouthwash is put on sale at $0.25, customers.... may tend to think of the product in terms of $0.25.... When, in subsequent weeks, the price increases to $0.39, these customers will tend to see it as overpriced, and are not inclined to buy it at this much higher price."

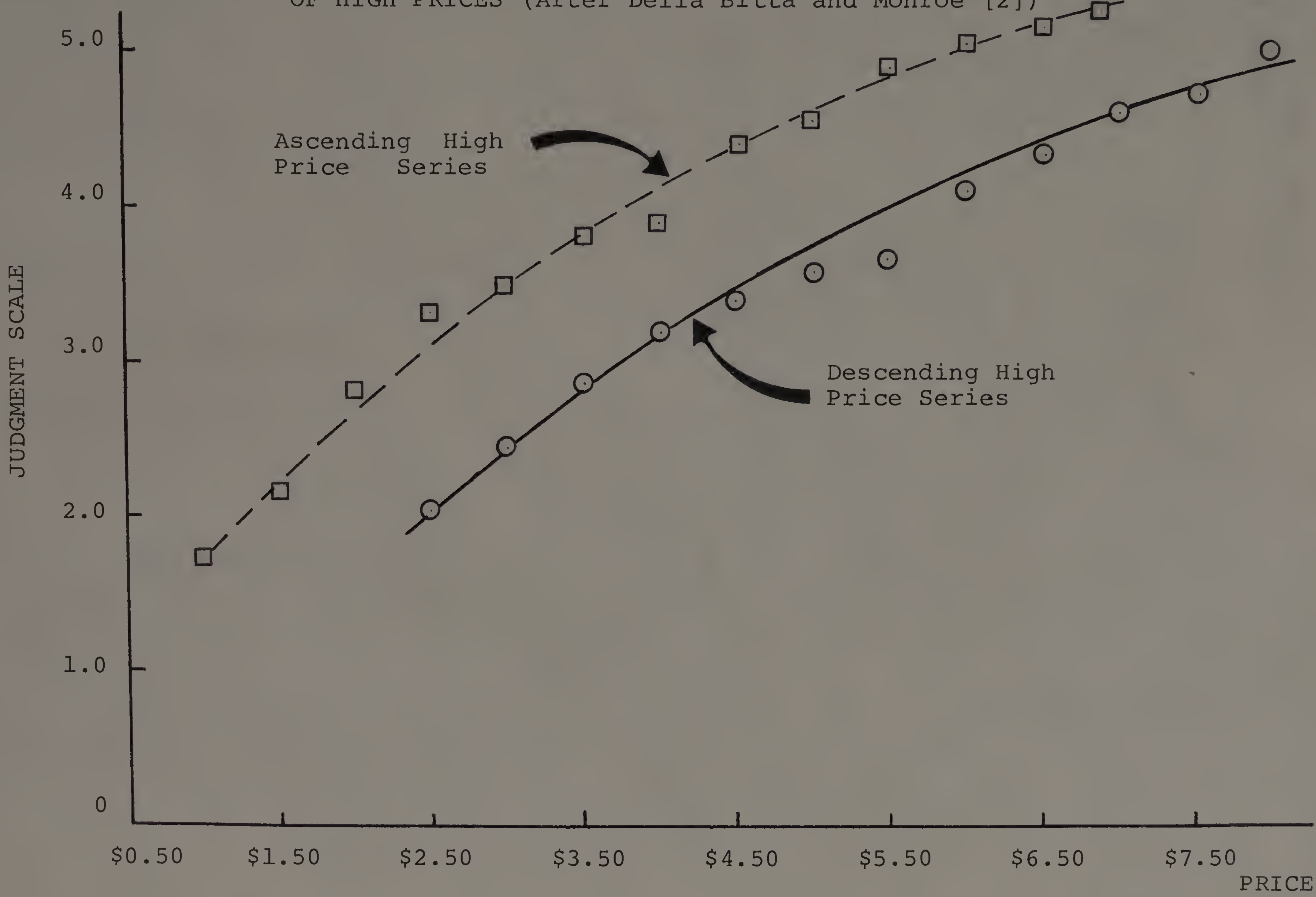
A pricing experiment that explicitly incorporates AL theory will now be described. AL theory predicts that if a series of stimuli are presented for judgment in order of increasing magnitude, the stimuli in the series will tend to produce higher categories of judgment than if the series were presented in order of decreasing magnitude. This is because, for any stimulus value in the ascending series, the weighted log mean (AL) of all the preceding stimuli is lower than the mean of the stimuli which would have preceded it if the series had been presented in descending order. Della Bitta and Monroe [2] tested the above prediction by presenting undergraduate students with sets of low and high prices for eight products. Within each price set, one group of subjects was presented the prices in ascending order, while a second group was presented the prices in descending order. Each price was rated on a seven-point scale.

A typical plot of mean judgment versus price obtained is shown in Figure 1 for aftershave high prices. The curves are negatively accelerated and look very much like the profiles obtained by psychophysicists working with other kinds of stimuli such as lifted weights. A function originally derived by Helson [11] was found to fit the data well. From it the implied adaptation levels were computed and 12 of the 16 possible cases showed descending AL higher than ascending AL, thus confirming the initial prediction.

Assimilation-contrast effects in pricing. A simple example of assimilation and contrast may first be given from sale pricing. If a brand is marked down not far below other offerings it may be perceived as a bargain (assimilation); however, if it is marked far below other brands it may be disbelieved as a real reduction from the original price (a contrast effect).

Figure 1

JUDGMENTS OF AFTERSHAVE PRICES SHOWING ANCHOR EFFECT OF HIGH PRICES (After Della Bitta and Monroe [2])



The work of Sherif [23] appears to be the first reported evidence in a pricing context of the effects of range of stimuli, choice of categories, assimilation and contrast, on judgment. The categories used when a subject selects their number and labels were studied in a 2 x 2 x 2 design as a function of latitude of acceptance[4] prevailing in two populations (American Indian and White high school students) the range of stimulus series (long and short), and the social value of objects (ordinary numerals and money, i.e., prices). The dependent measures were the number, width, and limits of categories selected by subjects. Consequently, the "own categories" technique of Sherif and Hovland [24] was used instead of the usual rating scale.

Latitudes of acceptable prices were first independently determined for the Indian and White students. Then for each experimental combination the subject was given a collection of slips of paper bearing numerals or prices and was asked to sort them into any number of piles or categories he might choose. In the case of prices the subject was to identify the piles with labels that could be ordered on a continuum having the extremes "too cheap" on the low end and "prohibitive" on the high end. The findings of this study are sum-

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[4] Latitude of acceptance is defined as the range of stimulus values judged acceptable by members of a group. In pricing it would mean the range of prices of a product judged acceptable by a buyer, or the prices included between the upper and lower price thresholds.

marized from Sherif [23, p. 155]:

1. The category widths and scale centers used by Indian and White subjects for the neutral series (numerals) did not differ significantly, but those for the valued series (prices) did.
2. When the price series range exceeded the latitude of acceptance, higher values were assimilated into acceptable categories, but the assimilation was limited by initial population differences in latitudes of acceptance. In addition, a contrast effect was operative as revealed in the tendency to lump together highly descrepant values into a broad objectionable category.
3. When the range of prices approximated the latitude of acceptance subjects divided it into fairly equal categories.
4. As a result of the interaction between internal anchor and stimulus range, subjects discriminated most keenly among the acceptable values when they were not faced with numerous objectionable items.

Overall, the results indicate the great importance of the stimulus range in detecting the effects of internal anchors. One point that should be made regarding this study is that it is not apparent how one may know when assimilation stops and contrast starts, if the price series exceeds the latitude of acceptance (see item 2 above).

In a more recent study, Downey [4] investigated the assimilation-contrast hypothesis by replicating the Sherif experiment using college students and an article of clothing (pants). Two price series -- long and short -- were applied, and the objective was to determine the effect of the length of the price series on the number of categories used, and the subsequent subjects' judgment of the prices.

Subjects' judgments did not significantly differ between the long and short series in terms of the number of judgment categories used. But the subjects' latitude of acceptance anchored their judgments producing a contrast effect when the price series was lengthened beyond their latitude of acceptance. Finally, a slight assimilation effect was shown by a lessened discrimination in the acceptable price range by subjects judging the long price series.

A few general comments will now be made regarding the application of AL concepts to pricing. First, there is a marked agreement among the studies that a buyer's judgment of prevailing prices is affected by his perception of a standard price either as a level or as a range of values. Yet the Doob et al. [3] study is the most explicit in demonstrating that buyers adapt to prices and resist their being raised. The lack of rigor of the several studies in establishing causal relationships and interactions of variables may be due in part to the following: (1) Some studies (e.g., Gabor and Granger [8], Kamen and Toman [13]) were consumer surveys with the well known difficulties in establishing causal relationships from survey results; (2) Other studies (e.g., Alexis et al. [1]) did not focus on AL and assimilation-contrast effects in their manipulations, but such concepts were suggested for explaining perplexing results. Only the Della Bitta and Monroe [2] experiment explicitly measured AL as a dependent variable, and the Sherif [23] and Downey [4] studies explicitly dealt with price range effects, assimilation, and contrast.

Second, only the study by Monroe and Della Bitta exploited the quantitative formulation of AL. According to AL theory, the shifts in judgment revealed in the several studies (including assimilation and contrast) are due to shifts in AL. A quantitative calculation makes the AL shift unequivocal.

Unresolved Research Problems

From the above review, the major unresolved research problems and other needed research are:

1. A more adequate understanding of how buyers perceive a set of price stimuli and respond to them. Several subproblems may be identified:

   (a) A study of the effects on judgment of the parameters (such as the arithmetic and geometric means, median, range, end prices) of the price structure of alternative brands in a product class. Parducci and his co-workers [19,21] using ordinary numerals and lengths of lines as stimuli, have shown that the median and the midpoint (average of the highest and lowest stimuli values) are useful in explaining the judgmental process and could be used to predict the adaptation level (the stimulus judged medium).

(b) The influence of a buyer's notion of a standard price for a product on the judgment of prices of alternative product offers has not been empirically established.

(c) It is known that often two or more brands of a product have the same price. The effects of the repetition of prices on perception have not received any research attention. Advertising researchers have long been interested in the effects of repetition of promotional information on buyer attitude. If price is regarded as a piece of information, the effects of repetition of such information should not be ignored by pricing researchers. It may be that when several brands of a product are marked at the same price, buyers perceive that price as "appropriate" for the product.

(d) Research evidence on assimilation-contrast effects is very meager. There is need to inquire deeper into the conditions under which one effect as opposed to the other will occur.

(e) There are some unresolved methodological problems regarding the study of differential price thresholds (perception of small price changes about a level). Specifically, there is disagreement whether Weber's law from psychophysics could be applied in a pricing context.[5]

2. There is a need to establish conceptual and methodological frameworks for the study of the above unresolved questions in the stimulus-response aspects of price. In this regard, adaptation-level theory seems to offer a useful but unvalidated conceptual foundation.

Summary

In this chapter it is suggested that the way buyers perceive the prices of products may be suitably studied by using a stimulus-response approach. Psychophysicists have long studied various types of stimuli, and some of their theories and methodologies have appealed to pricing researchers. One such theory, Helson's adaptation-level theory, is reviewed in some detail. The fundamental postulate of adaptation-level theory is that in a judgmental situation, focal, contextual and residual stimuli are pooled to determine an adaptation level to which all judgments of stimuli are relative. The

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[5] See the Journal of Marketing Research, May 1971, pp. 248-257 for a lively exchange.

adaptation level is the stimulus judged medium or neutral in the situation. A major attraction of the theory is its quantitative formulation in the form of a predictive equation and functions used to fit experimental data.

How buyers perceive and use the single cue, price, is not yet well understood. It is argued early in the chapter that research should first uncover how the different distributions and ranges of prices are perceived so as to pave the way for combining price with other cues like brand image, store image and so forth. Adaptation-level theory is suggested as a useful framework to attack the problem. Although the marketing literature has mentioned normal price, standard price or target price here and there, it appears that only one study has explicitly applied AL concepts and formulations.

Phenomena of assimilation and contrast which often occur in the judgment of stimuli are discussed, but again few pricing studies have been concerned with them.

From the literature review several unresolved research problems are identified.

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CHAPTER II

RESEARCH PROBLEMS AND DESIGN

From the set of unresolved research problems identified at the end of Chapter I, the effects of parameters of price structure and the standard price on judgment were chosen for study, using the framework of adaptation-level theory.

Research Problems

Before formally stating the research problems, the manner in which the concept of the standard price was used in this study will be explained.

The concept of "expected price". As indicated in Chapter I, researchers have used terms like "standard price," "normal price," "traditional price," to convey the idea that previous purchase experience or familiarity with the prices of a product establishes in the mind of the buyer some price level or narrow range of prices for the product. However, the term "expected price" might be more useful to identify the behavioral phenomena. That is, the price a buyer expects to pay during the next purchase (or in the near future) might influence the buyer's purchase behavior, and would be of greater interest to the buyer as well as the price-setter. It may be added that the influence of consumer expectation as an important determinant of future purchase intentions has been amply documented by Katona and his associates at the

University of Michigan Survey Research Center (e.g., [2]).

The descriptions, "standard," "fair," "normal," or "traditional," suggest a price recognized as normal for all buyers and seemingly ignore buyer differences in purchasing power and habits (e.g. a consumer may always purchase the higher-priced offerings). Though some products, indeed, may have what appears to be a traditional price (such as the 5-cent candy bar, when that was true), the concept of expected price can be applied to all products. Furthermore, it not only incorporates the buyer's previous experience with prices, but it also allows for changing conditions such as prevail during inflationary periods when prices are rising rapidly.

The specific problems investigated were:

Problem 1. Given a set of prices representing alternative brands of a product, to determine which parameters of the price set -- the geometric mean price, the midpoint price, or the median price -- significantly affects the adaptation-level price. The geometric mean price is the n^{th} root of the product of n prices, i.e.

$$\text{geometric mean price} = (P_1 . P_2 . \; . \; . \; P_n)^{1/n}$$

The midpoint price is equidistant between the lowest price P_1, and the highest price, P_n, i.e.

$$\text{midpoint price} = (P_1 + P_n)/2$$

The median price is the price in the middle position when all the prices are ordered from the lowest to the highest. One operational definition of adaptation-level price is the price judged "medium" by the buyer and, according to the theory, the "medium" price is the implicit frame of reference used to compare or judge the prices presented.

Problem 2. To derive and validate a model to predict the adaptation-level price for a given product class. Such a model should allow a determination of the relative importance of the expected price (as compared to the controllable parameters of the price structure) in predicting AL. Additionally, the model should be of practical use in price-setting.

Parducci and his co-workers, whose studies were reviewed in Chapter I, investigated problems similar to the above two, using numerals and line segments of different lengths as stimuli [3,4]. This research adapts their research procedure for price perception study. Furthermore, Parducci *et al*. did not manipulate the geometric mean in their experiments, but since that parameter is important in Helson's original definition of adaptation level (Equation 1-1)), it is included in this study. In effect, this study tests the Helson and Parducci formulations of AL in a pricing context. Methodological differences between the present work and the Parducci experiments will be discussed in Chapter III.

Research Objectives

There were three major objectives of the inquiry. First, to add evidence to what is known about the stimulus-response aspects of price. Specifically, to determine how the perception and judgment of the prices of alternative brands of a product are affected by key parameters of the set of prevailing prices for the product and by the buyer's expected price for the product.

Second, to provide additional evidence needed to validate the applicability of adaptation-level concepts, formulations, and methodology to price perception theory and research. That is, by expanding the hitherto scanty use of AL as a framework in pricing research, to permit a better assessment of the usefulness of that approach.

Third, to develop a model for AL price that would be useful in predicting buyers' judgments of various sets of prices.

Hypotheses

The following hypotheses were set up to test the effects of price parameters on AL:

> Hypothesis 1. Increasing the geometric mean of a set of prices presented for judgment, increases the adaptation-level price, if the mid-point and median are held constant.

> *Hypothesis 2*. Increasing the midpoint of a set of prices presented for judgment, increases the adaptation level price, if the geometric mean and median are held constant.

> *Hypothesis 3*. Increasing the median of a set of prices presented for judgment, increases the adaptation-level price, if the geometric mean and midpoint are held constant.

The parameters were hypothesized to have positive effects on AL because Helson's use of the geometric mean to define AL implies a positive effect, and Parducci and his co-workers found the midpoint and median produced positive shifts in AL. Testing the above hypotheses would reveal if these positive effects hold with price as stimulus.

Suppose now that buyers have a relatively high knowledge of market prices for a product, they are likely to have in mind a price they would expect to pay for the item. Consequently, the expected price is likely to be an important determinant of AL. Since the expected price is not directly controllable, its effect in determining AL may be estimated through a predictive model such as a regression model.

Design of Experiments

Controlled laboratory experimentation was chosen as a means of testing Hypotheses 1, 2, and 3, regarding the effects of the geometric mean, midpoint, and median on AL. For each product considered, the research plan was to test the effect of each parameter in a separate completely randomized design in which the parameter assumes two treatment levels -- "low" and "high".

It is mathematically difficult and rather clumsy to independently set the levels for the geometric mean, the midpoint and the median of a set of numbers, hence a factorial experiment was not adopted. Instead, by holding two parameters constant and varying the third, their separate effects on AL could be measured. The design, therefore, should be seen as three separate simple experiments as shown in Figure 2. For each experimental group, the dependent measure would be the adaptation-level price, namely the mean of the prices assigned to the medium category. The design shown in Figure 2 is similar to that used by Parducci and Marshall in their research on the judgment of lengths of lines [4].

Regression Models

To derive a predictive equation for the adaptation-level price, two basic regression equation forms were considered -- one based on Helson's theory, the other on Parducci's theory. Helson's defining equation for AL (equation (1-1)) was adapted in the following manner: The residual stimulus was replaced by the expected price, which, as has been argued, might be a more useful variable than "normal" or "standard" price. The contextual or background stimulus was replaced by those members of the price set that might be more conspicuous to a buyer and, therefore, have a special effect on AL in addition

Figure 2

EXPERIMENTAL DESIGN

Experiment 1 (Geometric mean varied, midpoint and median constant)

Low Geometric Mean	High Geometric Mean
Group 1	Group 2

Experiment 2 (Midpoint varied, geometric mean and median constant)

Low Midpoint	High Midpoint
Group 1	Group 2

Experiment 3 (Median varied, geometric mean and midpoint constant)

Low Median	High Median
Group 1	Group 2

to their contribution to the geometric mean. The lowest price of the set, the median price, and the highest price were considered to fall into this category, and were set up as contextual stimuli. To summarize, the predictive equation based on Helson's logarithmic mean definition of AL says that AL is determined by the geometric mean price (overall contribution of all the prices in the set), the price a buyer expects to pay, and special effects due to the lowest price, the highest price, and the median price of the set.

In equation form:

$$Y = B_o \, \overline{X}^p . X_l^q \, . \, X_h^r \, . \, X_m^s \, . \, X_e^t \qquad (2\text{-}1)$$

Or in logarithmic form:

$$\text{Log } Y = \text{Log } B_o + p\text{Log } \overline{X} + q\text{Log}X_l + r\text{Log}X_h + s\text{Log}X_m + t\text{Log}X_e \qquad (2\text{-}2)$$

where:

Y is the adaptation-level price;

$\overline{X}$ is the geometric mean of the price set;

X_l is the lowest price of the set;

X_h is the highest price of the set;

X_m is the median price of the set;

X_e is the buyer's expected price;

B_o, p, q, r, s, t are empirical constants.

The second regression model, which was based on Parducci's theory, simply states that the AL is a function of the midpoint price and the median price. This is a straightforward application of Parducci's hypothesis that the scale of judgment reflects a compromise between two tendencies: (1) to divide the stimuli into proportionate subranges; and (2) to use the alternative categories of judgment with proportionate frequencies. For example, if a subject were allowed only two categories of judgment, he would tend to divide the stimuli at midpoint in order to fix the width of the categories, and at the median in order to fix the frequencies with which the two categories are used.

In equation form:

$$Y = B_o + B_1 X_{mp} + B_2 X_m \qquad (2\text{-}3)$$

Where Y is the adaptation-level price;

X_{mp} is the midpoint price;

X_m is the median price;

B_o, B_1, B_2 are empirical constants.

Classical normal linear regression would be assumed in order to fit equations (2-2) and (2-3). The general linear model is [1]:

$$\overline{Y} = \overline{X}\overline{B} + \overline{e} \qquad (2\text{-}4)$$

Where: $\overline{Y}$ is the vector of observations on the regressand;

$\overline{X}$ is the matrix of observations on the regressors;

$\overline{B}$ is the vector of coefficients, and

$\overline{e}$ is the vector of disturbance terms (error) where the e_i are $N(0,\sigma_e^2)$, and $E(e_i, e_j) = 0$

Experiments 1, 2, and 3 (6 groups in all) provided some of the data needed to fit Equations (2-2) and (2-3). To provide more varied data, the research plan called for adding four new groups in which the geometric mean, the midpoint and the median were varied simultaneously instead of singly as in Figure 2. From the regression coefficients of either model, the "beta coefficients" were computed for the significant regressors, in order to determine the relative importance of the regressors in the equation.

In general,

$$B_j = b_j \frac{S_j}{S_y} \qquad (2\text{-}5)$$

where:

B_j is the beta-coefficient of regressor j;

S_j is the standard deviation of observations on regressor j;

S_y is the standard deviation of observations on the regressand y [1, p. 197].

Regression model validation. It was decided to attempt a validation of the best regression model obtained. It was planned to present actual market prices to a new group of subjects, and use the experimental groups to derive the equation, which would then be used to predict the adaptation levels of the new group. For this purpose, three new groups of subjects were added and were presented with prices prevailing in three different retail stores in the local Amherst area.

Towards a Generalization of Research Results

The research plan described so far could be executed using sets of prices of any products for which there is an adequate spread of prices. If sets of prices selected from normal price ranges for different products were studied and results were similar, there would be greater confidence that the findings might be generalizable. To this end, it was decided to study sets of prices of three different kinds of products -- ballpoint pens, alarm clocks (no radios), and adult's bicycles.

Summary

In Chapter II the problems of major concern to this inquiry are delineated. The concept of <u>expected price</u> is introduced and suggested as a more useful alternative to similar concepts conveying the idea of a normal price. After citing research objectives of contributing to both theoretical and practical knowledge in pricing, hypotheses are developed to probe the effects of the geometric mean price, midpoint price, and median price on adaptation level.

Next, the experimental design is described. For each product to be considered, three separate completely randomized designs are proposed to test the individual effects of the price parameters. Then regression models are fitted in order to obtain a predictive equation for adaptation level. Finally, the design allows for a validation of the best model.

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CHAPTER III

RESEARCH PROCEDURES

This chapter is concerned with the details of the research activities, namely, the selection of products and price sets, the preparation and pretesting of experimental instructions, the acquisition of subjects, and, finally, the experimental runs and collection of the data.

Selection of Products and Price Ranges

For practical reasons, it was decided to use undergraduates at the University of Massachusetts, Amherst, as subjects. The following considerations guided the choice of products:

1. Subjects should have use experience with the product, or otherwise be familiar with it. They should usually be the ones to make purchase decisions for the product.
2. The product should be one whose prices are likely to be compared by the buyer before purchase.
3. There should be a reasonable spread of market prices in a typical retail store carrying the item, which implies a relatively large number of alternative choices offered.
4. To minimize the number of subjects needed during the entire study, subjects were required to judge prices for all the experimental products. If the prices of

products overlapped, there would be the possibility of sensitization such that judgment of the prices of one product might bias the judgment of the prices of subsequent products. It is possible that the problem would not arise, since in real life shoppers regularly compare overlapping prices of different products and make seemingly independent judgments. Nevertheless, given the artificial laboratory situation, it was decided to select products whose typical market prices were in different ranges, but were narrow enough so as not to overlap significantly, and yet broad enough to permit any desired manipulation of the price parameters.

5. Because it was desired to use students of both sexes, the market prices of the chosen products should be about the same for both sexes, especially when different models of the product are made for male and female users.

The following products were chosen: ballpoint pen, alarm clock (without radio), and adult's bicycle (not for racing). To determine the range of prices to use during the experiment, a preliminary test was conducted to obtain approximate price ranges judged acceptable by students. Details of the test are presented in Appendix A. Students taking the introductory marketing course in the summer of 1974 participated in the pre-test.

Based on the data for acceptable price limits (Appendix A), and guided by the need to separate the price ranges while making them reasonably wide, the following price ranges were adopted for the experiments:

Ballpoint Pens	\$0.10 - \$3.00
Alarm Clocks	\$3.00 - \$25.00
Adult's Bicycles	\$45.00 - \$165.00

Selection of Experimental and Market Prices

In Experiments 1, 2, and 3, the geometric mean, midpoint, and median, respectively, were varied, while keeping the other two parameters of the price set constant. Altogether six groups of subjects were used, numbered 1 to 6. The design called for including four supplementary experimental groups (numbered 7 to 10) in which the geometric mean, midpoint, and median were varied simultaneously. Finally, three additional groups (numbered 11 to 13) were presented with actual market prices of the products. Thus, groups 1 to 10 judged experimental prices, while groups 11 to 13 judged market prices. The sets of prices presented to all the groups are listed in Appendix B; the price parameter values are shown in Tables 1, 2, and 3.

Experimental prices. The number of prices of each product given to every group that judged experimental prices was held constant at fifteen and each price appeared only once. Each ballpoint pen price ended with the digit '0' or '5' to the nearest cent (e.g., \$0.10, \$1.25); clock prices were whole dollars or ended with '.50' (e.g., \$5, \$12.50); bicycle prices

Table 1

EXPERIMENTAL PRICE PARAMETERS

Experiment 1: GM Varied, MP and MD Constant

		PEN	CLOCK	BICYCLE
		MP=1.55	MP=14	MP=105
		MD=1.55	MD=14	MD=105
Group 1	LOW GM	0.88	9.89	86.40
Group 2	HIGH GM	1.34	14.07	111.07

Experiment 2: MP Varied, GM and MD Constant

		PEN	CLOCK	BICYCLE
		GM=1.29	GM=12.42	GM=96.90
		MD=1.55	MD = 14	MD = 100
Group 3	LOW MP	1.20	11	90
Group 4	HIGH MP	1.80	16	117.50

Experiment 3: MD Varied, GM and MP Constant

		PEN	CLOCK	BICYCLE
		GM=0.96	GM=11.22	GM=102.26
		MP=1.55	MP = 14	MP = 105
Group 5	LOW MD	0.95	10	90
Group 6	HIGH MD	1.50	15	130

Key: All figures are in dollars
GM is the Geometric Mean Price
MP is the Midpoint (Average of highest and lowest prices)
MD is the Median price

Table 2

SUPPLEMENTARY EXPERIMENTAL PRICE PARAMETERS

		PEN	CLOCK	BICYCLE
Group 7	GM	1.15	9.53	93.32
	MP	1.40	10	90
	MD	1.10	9	115
Group 8	GM	1.28	10.21	91.69
	MP	1.80	14	112.50
	MD	1.00	11	85
Group 9	GM	1.07	6.48	74.64
	MP	1.15	8	80
	MD	1.65	7	75
Group 10	GM	0.61	12.60	97.59
	MP	1.05	16	100
	MD	0.75	10.50	95

Key: All figures are in dollars
GM is the geometric Mean
MP is the Midpoint (average of highest and lowest prices)
MD is the Median

Table 3

MARKET PRICE PARAMETERS

		PEN	CLOCK	BICYCLE
Group 11	GM	0.63	10.65	99.90
	MP	1.09	11.58	110
	MD	0.59	10.95	105
Group 12	GM	0.58	15.17	118
	MP	1.07	19.23	116.50
	MD	0.49	14	125
Group 13	GM	0.64	7.70	82.20
	MP	0.88	9.88	92.75
	MD	0.69	8.49	79.99

Key: All figures are in dollars
GM is the Geometric Mean
MP is the Midpoint (average of highest and lowest prices)
MD is the Median

were all whole dollars and no particular ending digit was favored. Within each price set, every effort was made to avoid having wide gaps between adjacent prices. In addition to the above criteria, the following conditions obtained while selecting prices for Experiments 1, 2, and 3 (Groups 1 to 6):

1. The labels "low" and "high" for the price parameters were merely convenient designations for two distinct levels of each parameter. For ballpoint pen and alarm clock parameters, every "low" value was incremented by about fifty percent to get the equivalent "high" value; for bicycle parameters, the increments were twenty-nine, thirty-one, and forty-five percent, for the geometric mean, midpoint and median, respectively.
2. Whenever the midpoint and median were held constant, their values in almost all the cases were equal to the midpoint, namely the average of the lowest and highest prices. The geometric mean could not be so easily controlled; it could be held constant at some level for only two groups at a time.
3. When the midpoint was varied, the "high" value was obtained by raising the lowest price of the set and the "low" by lowering the highest price. While varying the median, the midpoint was held constant by retaining the original end prices (highest and lowest).

A systematic procedure was followed in varying the three price parameters simultaneously as called for in groups 7 to 10. First, the parameters were tagged "high" (H) or "low" (L) in the first six groups. For example in group 1, the geometric mean, midpoint and median were tagged "L", "H", and "H", respectively. Then in selecting prices for groups 7 to 10, the parameter levels were set so that any permutations such as "L-H-H," which had occurred in earlier groups, were avoided. The objective was to avoid having the parameter values move in the same direction, which might lead to high correlations and possibly cause problems in fitting regression equations.

Market prices. Groups 11, 12 and 13 in the study were presented with prices prevailing in retail stores in the Amherst-Northampton area during the summer, 1974. Several criteria were used in the selections:

1. The prices chosen were within the price ranges already defined with the experimental prices, except for three cases -- two for clock prices and one for bicycle prices -- in which the range was exceeded on the high side by less than five dollars.
2. Fifteen distinct prices[1] were sought from each set of selections of the product. Typically, for ballpoint

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[1] If two or more brands were marked at the same price, that price was included only once to avoid possible confounding of results with the effects of repetition of prices.

pens and bicycles there were less than ten distinct prices, while alarm clock prices often exceeded fifteen. The prices were noted as they appeared, thus retaining the so-called magic prices which ended in ".95" or ".99".

3. Prices were taken from "expensive" as well as "cheap" stores.

The ballpoint pen prices were collected from the university store, a stationery store in Amherst, and a discount department store in Mountain Farms Mall in Hadley. Alarm clock prices came form the university store, a jewelry store in Northampton and the same discount department store in Mountain Farms Mall, Hadley, as mentioned above. Bicycle prices were selected at two independent bicycle shops in Northampton and from Sears Roebuck Company's 1974 Summer catalog.

Again, all experimental and market prices used are listed in Appendix B.

<u>Method of presenting prices</u>. The appropriate sets of prices for each product were presented to subjects who were asked to judge the prices on a low-high continuum. To simulate a shopping situation, subjects were asked to first examine and compare the prices before judgment. A convenient way to display the prices was to write each on a separate 3" x 2-1/2" card on which the name of the product was printed.

Each card represented an alternative selection or brand of the product and each subject received fifteen cards per product, or forty-five cards for the three products. A local printer was contracted to prepare three batches of 4,300 white cards each, with the words "BALLPOINT PEN", "ALARM CLOCK", and "ADULT'S BICYCLE" printed in bold characters across each card of the respective batch. A total of nearly 13,000 white cards were printed. Next, the specific prices were hand-written on the cards.

The judgmental continuum from extremely low prices to extremely high prices was broken into seven categories as shown in Figure 3. Each category was written boldly across a separate 3" x 2-1/2" orange-colored card. Hence, each subject used seven cards to judge one set of prices, or twenty-one cards for the three products. A total of 6,000 orange cards were printed.

Prices were presented in a random order. This method better represents actual shopping conditions than either an ascending or a descending order, and it minimizes order bias which has been shown to affect adaptation level [1]. To determine the order of presentation, prices were numbered 1 through 15, with 1 corresponding to the highest price and 15 corresponding to the lowest price of the set. A table of random numbers was entered and the first number between 0 and 16 encountered corresponded to the price placed at the top of the deck of white cards. The order of the numbers

Figure 3

CATEGORIES OF JUDGMENT FOR PRICES

(the order of stacking from the top) was: 13, 12, 5, 15, 2, 3, 10, 4, 11, 1, 7, 14, 9, 8, 6. This order was maintained in all the groups judging experimental prices and in groups judging market prices when the number of prices was 15. If the number of prices was less than 15, the higher numbers were ignored; for example, the price on the top of an 11-card deck would be the one numbered 5, since 13 and 12 would be ignored in the order shown above.

In the experimental instructions, subjects were asked to first inspect all the prices (white cards) and then sort them into as many of the seven judgmental categories (orange cards) as they saw fit. This method was thought to be a better simulation of having the shopper "handle the product" than presenting the prices on a sheet of paper or in a booklet form with a rating scale.[2] Besides, it seemed like a more interesting and involving task for the subjects.

At this point, it should be noted that the random order of presentation used in this study differs from the method used by Parducci and his co-workers in their experiments on the perception of numerals and lengths of lines [4,5]. In these experiments, the numerals were presented in ascending order of magnitude and lines in a descending order of magnitude. Like this study, however, the Parducci studies used

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[2]The booklet approach was tried in a pre-test, but it appeared too artificial, since the subjects were quickly flipping through the slips and making marks on paper.

the common approach of having subjects first examine all the stimuli before making their judgments.

Experimental Instructions

The instructions used in the experiments were in three parts. The first part dealt with the major task of judging sets of prices for the three products and is shown in Appendix C, Part I. The second part was a de-briefing questionnaire that included estimates of acceptable price limits and expected price; it is shown in Appendix C, Part II. The third part was a set of verbal instructions read aloud to the subjects when they were seated in the laboratory. It is shown in Appendix C, Part III and described later in the section on data collection.

Both Parts I and II of the instructions were pre-tested in the summer of 1974 using the same subjects described above. Sets of prices for groups 1 to 6 (Experiments 1, 2, and 3) of the design were presented to the subjects. The major objective of the pre-test was to see if subjects understood and followed the instructions properly. The subjects overwhelmingly reported that the procedures were clear, so only minor adjustments were necessary to get the final version. Furthermore, the pre-test showed that no subject came close to guessing the intent of the study, thereby suggesting that demand characteristics were not likely to be present during the experiment. Demand characteristics in experimentation arise when subjects guess the purpose of the experiment and respond to it rather than, or in addition to, the manipulated variables [3,7].

The data on price judgments were not of interest in the pre-test because no more than four subjects participated in each experimental group. There was no doubt about the manipulation of the price parameters since their values were precisely known; whether the adaptation level was significantly affected by such manipulations, however, had to await the collection of sufficient data in the actual experiment.

The instruction sheets for Part I were handed to each subject together with a large 9" x 12" brown envelope containing three sets of white cards with prices written on them, three sets of orange cards with categories of judgment printed on them, and some rubber bands. The instructions began by asking the subject to empty out the envelope and note its contents. Then he was to imagine that he was shopping for a ballpoint pen, an alarm clock, or an adult's bicycle, and that in each case the store carried a wide product selection marked at different prices. The white cards represented the different offerings. The order of judgment of the sets of prices had been pre-determined randomly and it was: ballpoint pen prices first, alarm clock prices second, and bicycle prices last. This order was maintained throughout the study. Each set of white cards had been randomly stacked, as described above.

After spreading out the white cards on the table, the subject was asked to pick, on the basis of price alone, his first choice, second choice, and third choice, respectively, of the appropriate product. It was thought that this preliminary step would get the subject better involved in the experiment by forcing him to take a good look at the prices presented than otherwise. The major task for the subject was to spread out the seven orange cards representing judgmental categories from "Extremely Low Price" through "Medium Price" to "Extremely High Price," and then to assign the white cards (prices) to the categories, using only those categories that seemed appropriate. The prices assigned to any category were visible at all times, and the subject was encouraged to rearrange them as he saw fit; when satisfied, he was to use a rubber band and tie each orange card together with the white cards assigned to it.

In the debriefing questionnaire the subjects were first asked their sex. Then their acceptable price limits and expected price for the three products were estimated in a manner identical to that described in Appendix A. In the price scales presented, ballpoint pen prices went from $0.02 to $5, alarm clock prices $1 to $30, and adult's bicycle prices $15 to $190. The range of acceptable prices would indicate whether the experimental or market prices administered were too high or too low for some subjects. The subject's expected price for each product was obtained by asking him to mark on the appropriate price scale "the price you would expect to pay today, if you purchased the item for your own use." Awareness or knowledge of market prices for each product was probed by requiring a checkmark to be put in one of three categories: "not aware," "somewhat aware," and "generally aware." It was thought that this variable might be useful in discriminating between subjects in each group with respect to their adaptation levels.

An open-ended question probed what guidelines the subject used in judging the prices. In addition to being asked what they thought the experimenter was trying to find out, the subjects were required to write their opinions on the clarity of the instructions and to describe how much care they had exercised in carrying out the tasks.

Sample Selection and Data Collection

Early in the planning of the study, it was decided to draw subjects from the undergraduate classes in the School of Business Administration of the University of Massachusetts, Amherst. A total of 285 undergraduates participated in the study; 202 were males and 83 females. Of the total number, 168 came from the introductory marketing course, which usually attracted about half the enrollment from departments of the university other than the School of Business Administration; 51 came from a buyer behavior course, 47 from a marketing research course, and 19 were volunteers. The distribution of subjects over the thirteen groups used in the study are shown in Table 4.

It was planned to conduct the experimental sessions during meeting hours for the classes and to have the students attending class that day go from their classrooms to the behavioral science laboratory in the same building. A total of seventy-five dollars in prize money was offered to fifty students drawn randomly from the entire list of participants at the end of the experimental sessions.

There were several reasons for not asking the subjects to volunteer freely. First, the number of subjects required was fairly large and volunteering would have been a slow way to obtain the desired number of subjects. In a preliminary test of the experimental instructions in the spring of 1974 (before the full-scale trial of the summer), volunteers were sought with disappointing results even when financial inducement was offered. Furthermore, nine of the nineteen volunteers who took part in the full study were obtained after soliciting in six different classes. Second, the investigation was conducted on a very limited budget, which precluded offering a reasonable financial inducement to a large number of subjects. Third, critics of experimental designs often argue that volunteers in an experiment might be different from non-volunteers, and research findings might accordingly be biased [6]. Using volunteers may not be an unmitigated blessing. (Incidentally, the debriefing questionnaire in-

Table 4

DISTRIBUTION OF SUBJECTS IN EXPERIMENTAL GROUPS

Experiment 1. Geometric Mean Varied

Group 1 (Low) N=24	Group 2 (High) N=24

Experiment 2. Midpoint Varied

Group 3 (Low) N=23	Group 4 (High) N=25

Experiment 3. Median Varied

Group 5 (Low) N=23	Group 6 (High) N=23

Supplementary Experimental Prices (All Parameters Varied)

Group 7 N=23	Group 8 N=23	Group 9 N=23	Group 10 N=23

Market Prices

Group 11 N=17	Group 12 N=17	Group 13 N=17

cluded an open-ended question asking for the subject's comments. No comment suggested unhappiness over the manner in which the subject was made to participate.) Finally, since all the students were taking marketing courses, their participation might perhaps be explained on academic grounds -- to make the students experience firsthand the kind of research that is frequently cited in their textbooks and in class.

Experimental runs. The experiments were conducted very early in the fall semester of 1974 over a period of ten days. Students from scheduled classes were run in eleven laboratory sessions spread over the first eight days, and volunteers came at appointed times in the last two days.

In order to spread out the variation due to holding the laboratory sessions at different times and drawing subjects from different classes, the data for each experimental group were collected over several sessions. Hence, prices for different experimental groups were presented together during any given laboratory session. The usual injunction in experimental work to randomly assign subjects to groups and randomly assign groups to treatments was approximated by randomly stacking the envelopes containing price sets for the groups being run together and then serially handing them out to subjects after they were seated in the laboratory. Table 5 shows the groups which were run together, the number of envelopes handed out from each group, and the randomized

Table 5

SEQUENCE OF EXPERIMENTAL RUNS

Order of Run	Groups Involved	Number of Subjects	Order of Envelope Stacking
1	1-6	23 ea	5,4,2,1,3,6
2	7-13	15 ea	13,11,8,9,10,12,7
3	7-10	8 ea	8,9,10,7
4	11-13,6	2 ea	Irregular

group order used.

The instructors whose classes participated in the experiment were contacted at least one week in advance to get their co-operation. It was felt that such co-operation would be easier to get if the experiments were held early in the semester than later. With the exception of the marketing research class, the students were not informed in advance that they would participate in a laboratory exercise. On the appointed day the author (hereafter called the experimenter) went to the appropriate room at the beginning of class and was introduced by the instructor. The experimenter then told the students that they would be asked to participate in a laboratory exercise relating to the behavioral aspects of prices. He added that subjective perceptions as well as considerations of cost were important inputs into buyers' judgment of prices and purchase decisions, and that the students would be having a firsthand experience of the kind of research that explored those phenomena. The class was next told that about 280 students in all would be needed and out of that number fifty names would be randomly drawn and each person given $1.50. Finally, the class was assured that the exercise would not be a group activity, and each individual would follow instructions at his own pace and carry out tasks that involved sorting cards.

The students were then asked to follow the experimenter and the class instructor to the laboratory. No attempt was made to ensure that every student went down to the laboratory; indeed, in some classes a few students wandered off on the way. In the laboratory, the subjects were told to take any seats they wished. When everyone was comfortably seated, the experimenter checked to see that each person had enough table surface to work with and then read aloud a set of instructions shown in Appendix C, Part III. Essentially, the subjects were told to proceed one step at a time and not read ahead of themselves, to work individually and not talk with neighbors.

The first part of the experimental instructions (Appendix C, Part I) and the envelopes containing price cards were handed out in the order shown in Table 5, depending upon the combination of experimental groups being run together. During the early steps in the procedures, the experimenter usually circulated among the subjects to make sure each one started out right with the first set of cards -- ballpoint pen prices. In all, very few subjects needed the extra orientation. Except for occasional problems with cards (errors in card preparation), everything went smoothly and the subjects appeared to be really involved in their tasks. As soon as each subject finished the price judgments, he was given the debriefing questionnaire to fill out (Appendix C, Part II). The last act by each subject was to fill out a slip with his name, address, and phone number to be used in the random draw of people to be compensated. The entire procedure typically took twenty-five to thirty minutes to complete.

About half-way through the data collection, the experimenter took a random sample of twenty envelopes, to check for proper execution of instructions. The data were overwhelmingly in order; he then proceeded to collect the rest of the data.

When all the data were in, a quota sampling scheme was adopted in drawing the fifty subjects to be compensated. That is, names were drawn randomly from each class in proportion to the number of students who came from that class. All the winners were notified, and the $75 paid out.

Summary

The detailed activities involved in implementing the research plan are described in this chapter. Based on stated criteria, ballpoint pen, alarm clock, and adult's bicycle were the products whose prices were studied. Guidelines for the selection of experimental prices are indicated, and those prices as well as market prices are exhibited. Prices for each product were written on cards on which the product's name was pre-printed. Subjects were required to examine all the prices for each product before assigning them to categories of judgment.

The various pre-tests of experimental procedures are described, and the final experimental instructions are summarized and exhibited. Two hundred and eighty-five undergraduate students participated in the study; the manner in which they were obtained is explained. Experimental runs lasted for ten days, and the typical laboratory session is described.

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CHAPTER IV

RESULTS AND ANALYSIS

The results of the research are presented in this chapter and are organized in four succeeding sections: (1) tests of the research hypotheses, (2) derivation and validation of the predictive equations for adaptation-level price, (3) summary of responses from the debriefing questionnaire, and (4) analysis of data on the rankings of price choices.

Preliminary Procedures

The data were tabulated and checked for any irregularities. One subject in group 11 made highly inconsistent assignments of clock and bicycle prices, and his data for those products were deleted from further analysis. For example, in an increasing order of clock prices, he assigned two adjacent prices to "low," the next three to "high," the next to "medium," the next to "low," the next three to "high," the next two to "very high," the next to "medium" and the last price to "very high."

To search for other cases warranting deletion, the responses to certain debriefing questions were reviewed. When asked how clear the experimental procedures were, 275 of the 285 subjects wrote "very clear" or "extremely clear" and ten replied that the instructions were either moderately clear or were initially confusing. In response to how much care was exercised in making the price judgments, 279 wrote that they were very careful or exercised reasonable care, six indicated they exercised "so-so" care, perhaps implying a lower degree of involvement in the task. No data were deleted due to responses to these two questions, because the small number of different responses indicated that instruction clarity and subject involvement were present during the experiment.

Evidence of demand characteristics was probed by asking the subjects to indicate what they thought the experiment's objective was. Responses varied and included speculations concerning the price-quality relationship, individual values and beliefs about prices, or subject's consistency in price judgments. One subject nearly identified the true purpose of the study when he observed that the purpose of having handwritten prices on the cards was to shift the range among the subjects to see if the "median" price would shift toward the center of the range. His data were deleted in subsequent analysis. Thus, the data of two subjects (this one and the one who made inconsistent choices) were deleted in the entire sample.

Computing the dependent measure. The major dependent variable in the study was adaptation-level price, namely, the price judged "medium" by each subject. The AL price was obtained by averaging all the prices assigned to the "medium" category. If a subject did not use the "medium" category, the lowest price assigned to "high" and the highest price assigned to "low" were averaged; if the "low" was not used, the lowest price assigned to the "high" was then taken as the adaptation level.[1] When computed as above, the AL is at least interval-scaled, since it is an average of prices, which are ratio scaled. The categories of judgment used (Figure 3 in Chapter III) were labels and they were not scaled.

Major computations on the data were made using the University of Massachusetts Computer Center version of SPSS -- Statistical Package for the Social Sciences [12]. Sample arithmetic means and variances of AL's were computed for the experimental groups (Groups 1 to 6) and are shown in Tables 6, 7, and 8 for pens, clocks, and bicycles, respectively.

It was pointed out in Chapter I that the AL represents a narrow continuum on the stimulus scale, although it is commonly represented by a single value. The data showed that subjects often assigned more than one price to the "medium" category. The mean number of prices so assigned was computed by group for each product and was found to vary between two and five in the entire data. Grouping

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[1]There were only 22 instances of not using the "medium" category in 849 possible cases (283 subjects each judging prices of three products).

Table 6

GROUP MEAN AND VARIANCE OF ADAPTATION LEVELS FOR PEN PRICES -- EXPERIMENTAL GROUPS

		LOW	HIGH
		Group 1	Group 2
EXPT. 1	N	24	24
GM Varied	$\overline{X}$	\$0.97	\$1.38
(MP & MD Const.)	S^2	\$0.14	\$0.14
		Group 3	Group 4
EXPT.2	N	23	25
MP Varied	$\overline{X}$	\$1.21	\$1.06
(GM & MD Const.)	S^2	\$0.11	\$0.13
		Group 5	Group 6
EXPT. 3	N	23	23
MD Varied	$\overline{X}$	\$0.94	\$1.00
(GM & MP Const.)	S^2	\$0.08	\$0.19

Key: N is the number of usable cases
$\overline{X}$ is the group mean AL price
S^2 is the group variance of AL price
GM is the geometric mean of the price set
MP is the midpoint of the price set
MD is the median of the price set

Table 7

GROUP MEAN AND VARIANCE OF ADAPTATION LEVELS
FOR CLOCK PRICES -- EXPERIMENTAL GROUPS

		LOW	HIGH
		Group 1	Group 2
EXPT. 1	N	24	24
GM Varied	$\overline{X}$	$8.60	$11.54
(MP & MD Const.)	S^2	$8.77	$12.73
		Group 3	Group 4
EXPT. 2	N	23	25
MP Varied	$\overline{X}$	$9.87	$9.70
(GM & MD Const.)	S^2	$6.85	$6.57
		Group 5	Group 6
EXPT. 3	N	23	23
MD Varied	$\overline{X}$	$9.07	$10.78
(GM & MP Const.)	S^2	$3.83	$6.12

Key: N is the number of usable cases
$\overline{X}$ is the group mean AL price
S^2 is the group variance of AL price
GM is the geometric mean of the price set
MP is the midpoint of the price set
MD is the median of the price set

Table 8

GROUP MEAN AND VARIANCE OF ADAPTATION LEVELS FOR BICYCLE PRICES -- EXPERIMENTAL GROUPS

		LOW	HIGH
		Group 1	Group 2
EXPT. 1	N	24	24
GM Varied	$\overline{X}$	\$80.33	\$91.08
(MP & MD Const.)	S^2	\$413.72	\$509.51
		Group 3	Group 4
EXPT. 2	N	23	25
MP Varied	$\overline{X}$	\$90.23	\$96.22
(GM & MD Const.)	S^2	\$288.47	\$188.80
		Group 5	Group 6
EXPT. 3	N	23	23
MD Varied	$\overline{X}$	\$87.05	\$92.79
(GM & MP Const.)	S^2	\$152.20	\$559.37

Key:
N is the number of usable cases
$\overline{X}$ is the group mean AL price
S^2 is the group variance of AL price
GM is the geometric mean of the price set
MP is the midpoint of the price set
MD is the median of the price set

prices may indicate that the subject perceived the grouped prices as not being "noticeably" different (JND concept or differential threshold concept), or it may be nothing more than the subject's attempt to get through the task of assigning fifteen prices to a maximum of seven judgmental categories.

Tests of Hypotheses: Analysis of Variance

A check of ANOVA assumptions. Before performing one-way analyses of variance to test the three research hypotheses, the data were analyzed to confirm they were consistent with the assumptions of ANOVA. The usual ANOVA assumptions are (e.g., [9, p. 713]): (i) For each treatment population, the distribution of experimental errors is assumed normal (which implies that the distribution of dependent variable measures is normal). (ii) For each population, the distribution of experimental errors has a variance which is assumed to be the same for each treatment population -- homogeneity of variance. (This implies that each population has the same variance of dependent variable observations.) (iii) The errors associated with any pair of observations are assumed to be independent.

The third assumption--independence of errors--should be met in the data because the dependent measure -- AL -- was not repeated on the same subject. On the possible departures from normality and homogeneity of variance, one suggestion is to make the group sizes large and equal [9, p. 725]. With group sizes in the range twenty-three to twenty-five, and actually equal in Experiments 1 and 3, the above criteria seem satisfied. Furthermore, evidence from the statistical literature indicates that the distribution of ratio of mean squares (F-ratio) seems little affected by departures from normality [11, p. 71].

Methods for detecting heterogeneity of variance have been proposed by Bartlett [3], Cochran [4] and Hartley [8]. Although there are some doubts about the usefulness of these tests on the grounds that they are overly sensitive to departures from normality [11, p. 72], the tests were performed on the data. Values of Cochran's C (Max. Variance/ Sum of Variances), Bartlett - Box F, and Hartley's Max. Variance/Min. Variance were computed. Each test showed that, in the two-treatment groups of the experiments, the null hypothesis:

$$Ho: \ \sigma_1^2 = \sigma_2^2$$

was accepted strongly in Experiments 1 and 2 for all three products and in Experiment 3 for clocks. The hypothesis was rejected in Experiment 3 for pens and bicycles ($p<0.05$, and $p<0.01$, respectively). Since only two treatment groups were involved in each experiment, Hartley's Max. Variance/Min. Variance corresponds to the basic F-ratio for testing the significance of the difference between the variances of two populations. That test is therefore the most direct for the hypothesis.

Bartlett [2] has presented a formula for deriving transformations on the data that may stabilize the within-group variances and may also result in a closer approximation to the normal distribution. Three of the more useful transformations are the square-root transformation, the arc sine transformation, and the logarithmic transformation, which seem appropriate when the data are frequency counts, proportions, or markedly skewed, respectively [11, p. 77]. Since the values were generally greater than unity, the arc sine transformation would not apply; instead the square root and logarithmic transformations were made (see Appendix D). The transformations did not result in any appreciable reduction of heterogeneity of variance. It was decided to leave the matter at this point. That is, the transformations were omitted and raw scores used in the ANOVA.

All in all, the hypothesis of homogeneity of within-group variances was accepted in seven of nine tests.

Hypothesis 1. Hypothesis 1 states that increasing the geometric mean of a set of prices presented for judgment increases the adaptation-level price, if the midpoint and median are held constant. To test this hypothesis for two treatment groups, "low" geometric mean and "high" geometric mean, the null and alternative hypotheses are:

$$Ho: \mu_H = \mu_L$$

$$H_1: \mu_H > \mu_L$$

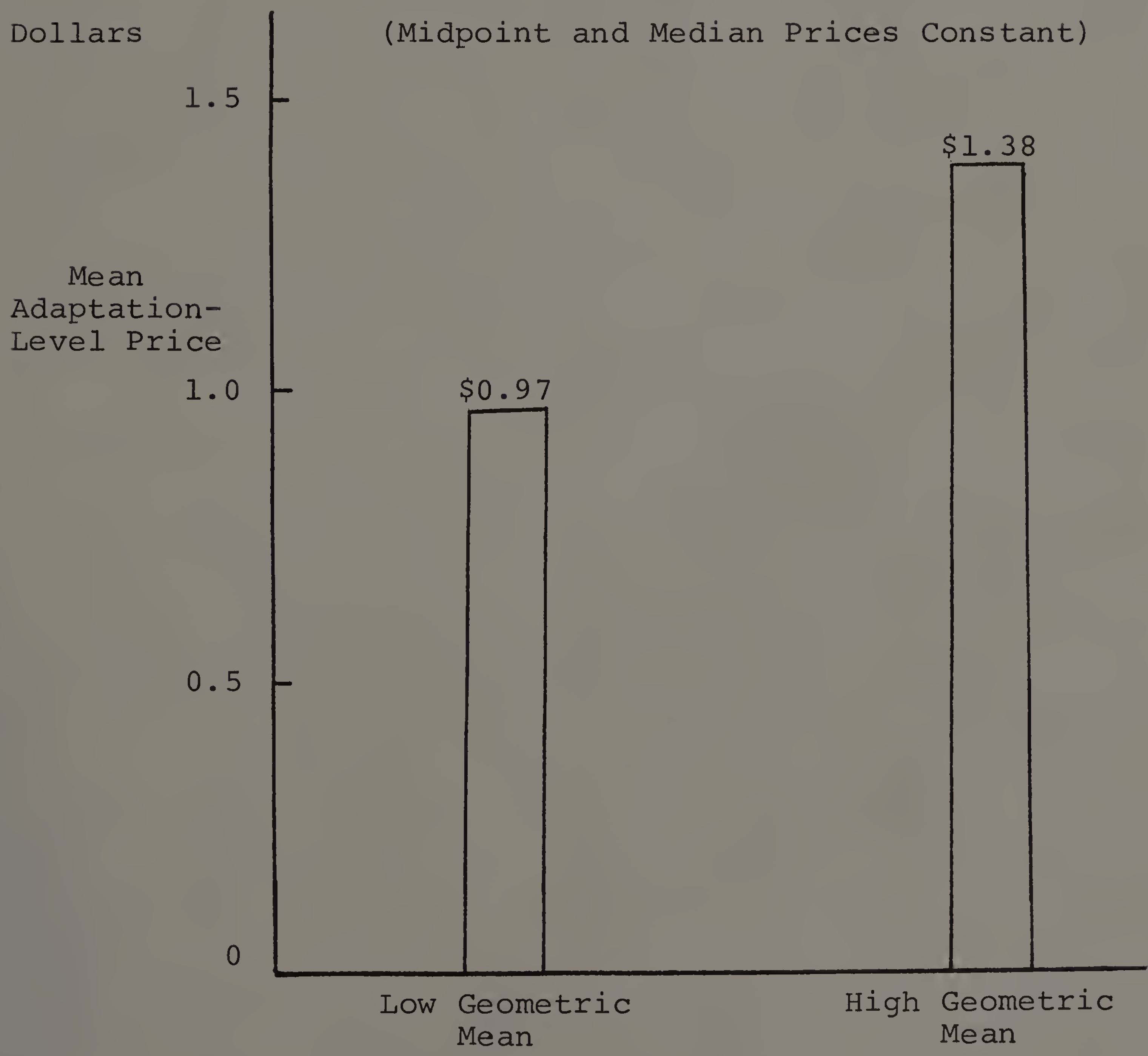
where μ_H is the population mean AL for the "high" geometric mean group and μ_L is the population mean AL price for the "low" group. A direct test of the hypothesis would be a one-tailed t test. Nevertheless, in keeping with the tradition of experimental analysis and to provide richer information, tables of analysis of variance (ANOVA) were prepared.

First, bar charts were prepared in order to display the differences in mean AL between the "low" and "high" geometric mean groups. These are shown in Figures 4, 5, and 6 for pens, clocks, and bicycles, respectively. Values of t from a test of the significance of the difference between the pairs of mean AL's are also given together with p-values (one-tailed). The results show that for all three product categories, the mean AL price for "high" geometric mean is greater than the mean AL price for "low" geometric mean. These differences are significant for pens and clocks ($p < 0.002$) and for bicycles ($p < 0.05$). Thus, the results strongly support Hypothesis 1.

The analysis of variance model for a completely randomized one-factor design is in this case:

Figure 4

MEAN RESPONSE LEVELS FOR TREATMENT CONDITIONS OF LOW AND HIGH GEOMETRIC MEAN FOR PEN PRICES

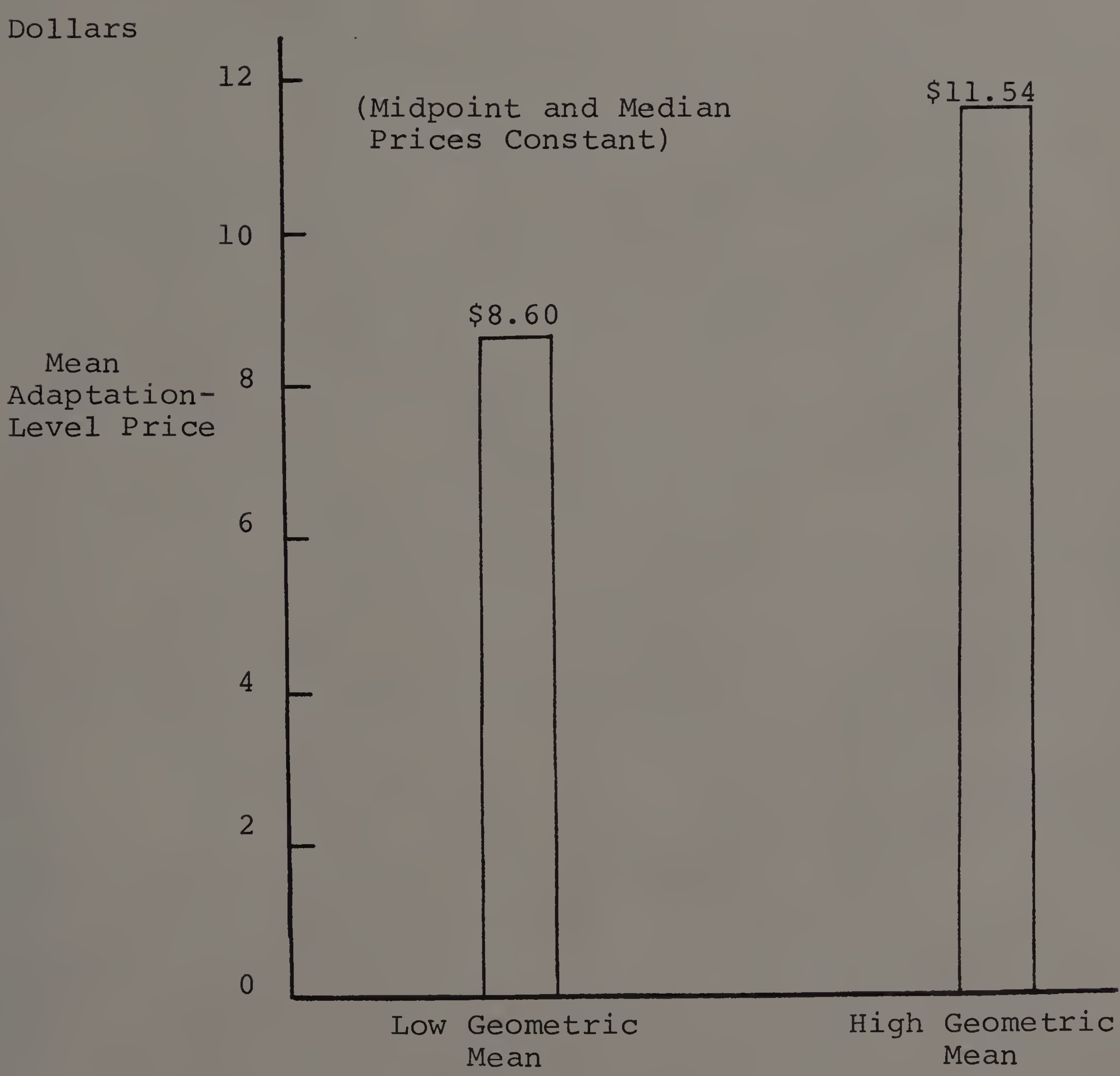


t = 3.749 df = 46

p = 0.00 (one-tailed)

Figure 5

MEAN RESPONSE LEVELS FOR TREATMENT CONDITIONS OF LOW AND HIGH GEOMETRIC MEAN FOR CLOCK PRICES

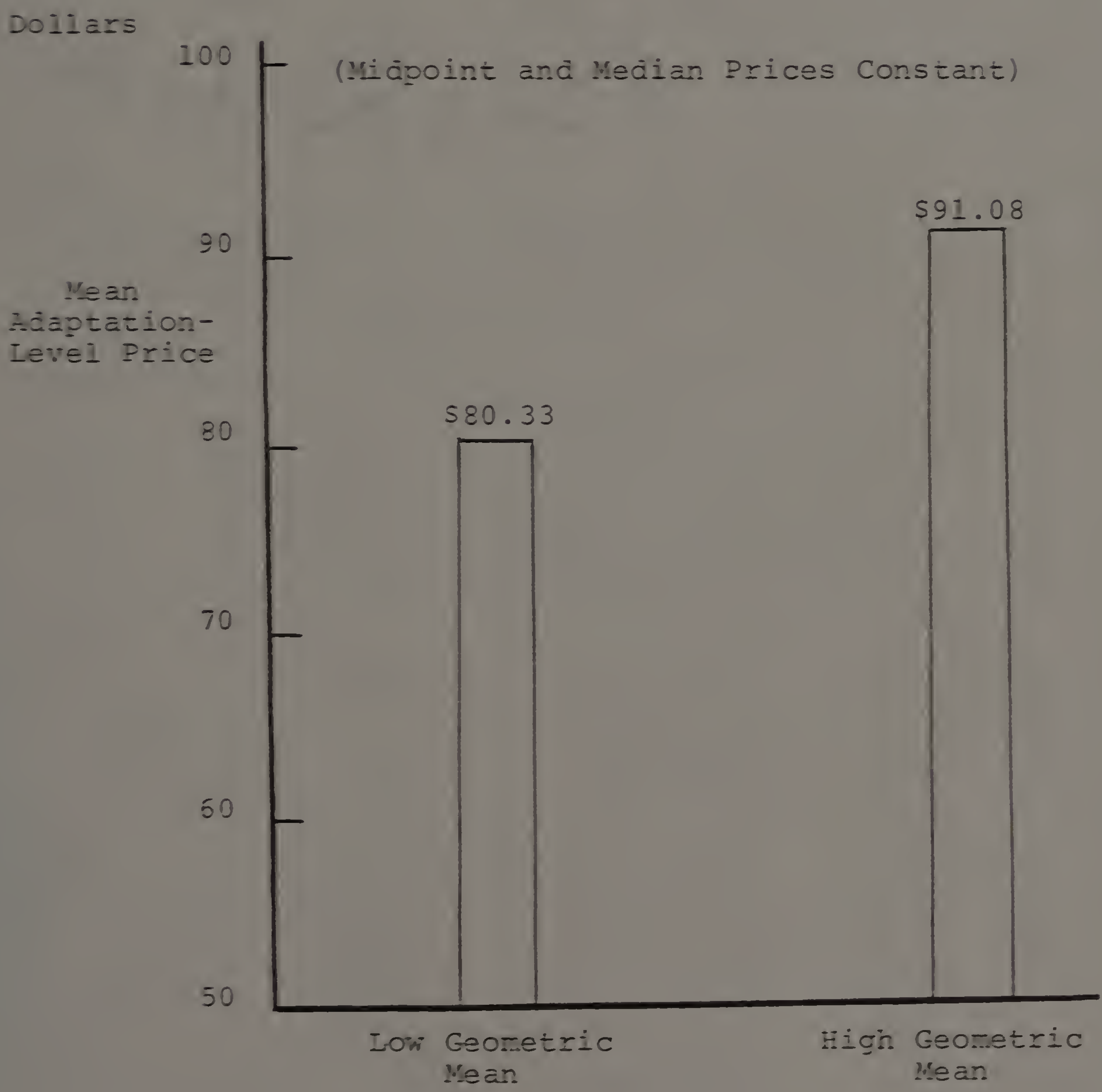


$t = 3.102$ df = 46

$p = 0.00$ (one-tailed)

Figure 6

MEAN RESPONSE LEVELS FOR TREATMENT CONDITIONS OF LOW AND HIGH GEOMETRIC MEAN FOR BICYCLE PRICES



$t = 1.733$ $df = 46$

$p = 0.045$ (one-tailed)

$$Y_{ij} = \mu + \alpha_j + e_{ij} \qquad (4\text{-}1)$$

$$i = 1,\ldots n_j,\; j = 1,2.$$

where: Y_{ij} is the AL price of subject i in treatment group j;

μ is the grand mean of the two treatment populations;

α_j is the effect associated with treatment j;

e_{ij} is a random error term;

n_j is the number of subjects in treatment group j.

The analysis of variance tables are presented in Table 9 for the three products. As expected in a completely randomized one-factor design, the tables show large sums of squares due to error (within group variance). These are offset by the large number of degrees of freedom for error in the error mean square. The F probabilities are twice the one-tailed t probabilities reported with the bar charts (Figures 4-6), since they correspond to an alternative hypothesis:

$$H_1 : \mu_H \neq \mu_L$$

where μ_H is the mean AL price of the "high" geometric mean treatment group and μ_L is the mean AL price of the "low" geometric mean treatment group.

<u>Hypothesis 2</u>. This hypothesis states that increasing the midpoint (average of the highest and lowest) of a set of prices presented for judgment increases the adaptation-

Table 9

ANALYSIS OF VARIANCE TABLES FOR TREATMENT CONDITIONS OF LOW AND HIGH GEOMETRIC MEAN OF PRICE SETS

BALLPOINT PEN

Source	SS	df	MS	F	F Prob.
Treatments (between groups)	1.956	1	1.956	14.054	0.000
Error (within groups)	6.403	46	0.139		
Totals	8.359	47			

CLOCK

Source	SS	df	MS	F	F Prob.
Treatments	103.459	1	103.459	9.625	0.003
Error	494.446	46	10.749		
Totals	597.905	47			

BICYCLE

Source	SS	df	MS	F	F Prob.
Treatments	1385.783	1	1385.783	3.002	0.090
Error	21234.326	46	461.616		
Totals	22620.109	47			

level price, if the geometric mean and median are held constant. The null and alternative hypotheses are:

$$H_o : \mu_H = \mu_L$$

$$H_1 : \mu_H > \mu_L$$

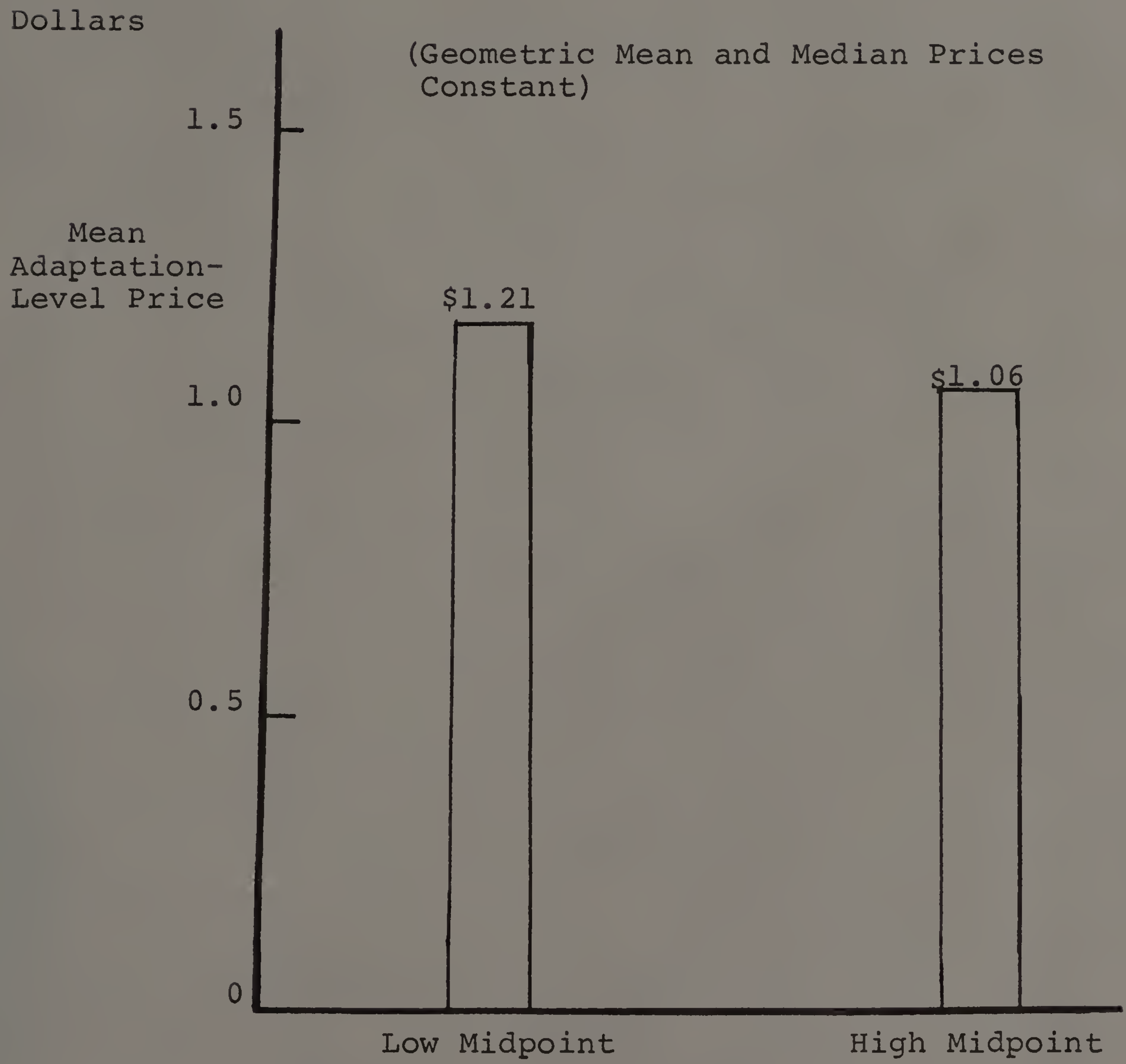
where μ_H is the population mean AL price of the "high" midpoint treatment group and μ_L is the population mean for the "low" midpoint group.

Bar charts portraying the mean response levels for the pairs of treatment groups are shown in Figures 7, 8, and 9 for pens, clocks, and bicycles, respectively. The data indicate that for pens and clocks the mean AL price for the condition of "low" midpoint is greater than for "high" midpoint -- a reversal of the hypothesized relationship. The difference for bicycles is in the expected direction. As the t values show, none of the differences is significant at the 0.05 level (one-tailed). At the 0.10 level (one-tailed) the reversal for pens is significant, and although the positive difference for bicycles is significant, it is evident that the results overall do not support Hypothesis 2.

Analysis of variance tables for the data are in Table 10. The data for clocks show that the treatment mean square is considerably less than error mean square, thus the usual F-ratio is less than unity. This warrants a closer look. To test for significance at the lower tail of the F distri-

Figure 7

MEAN RESPONSE LEVELS FOR TREATMENT CONDITIONS OF LOW AND HIGH MIDPOINT FOR PEN PRICES

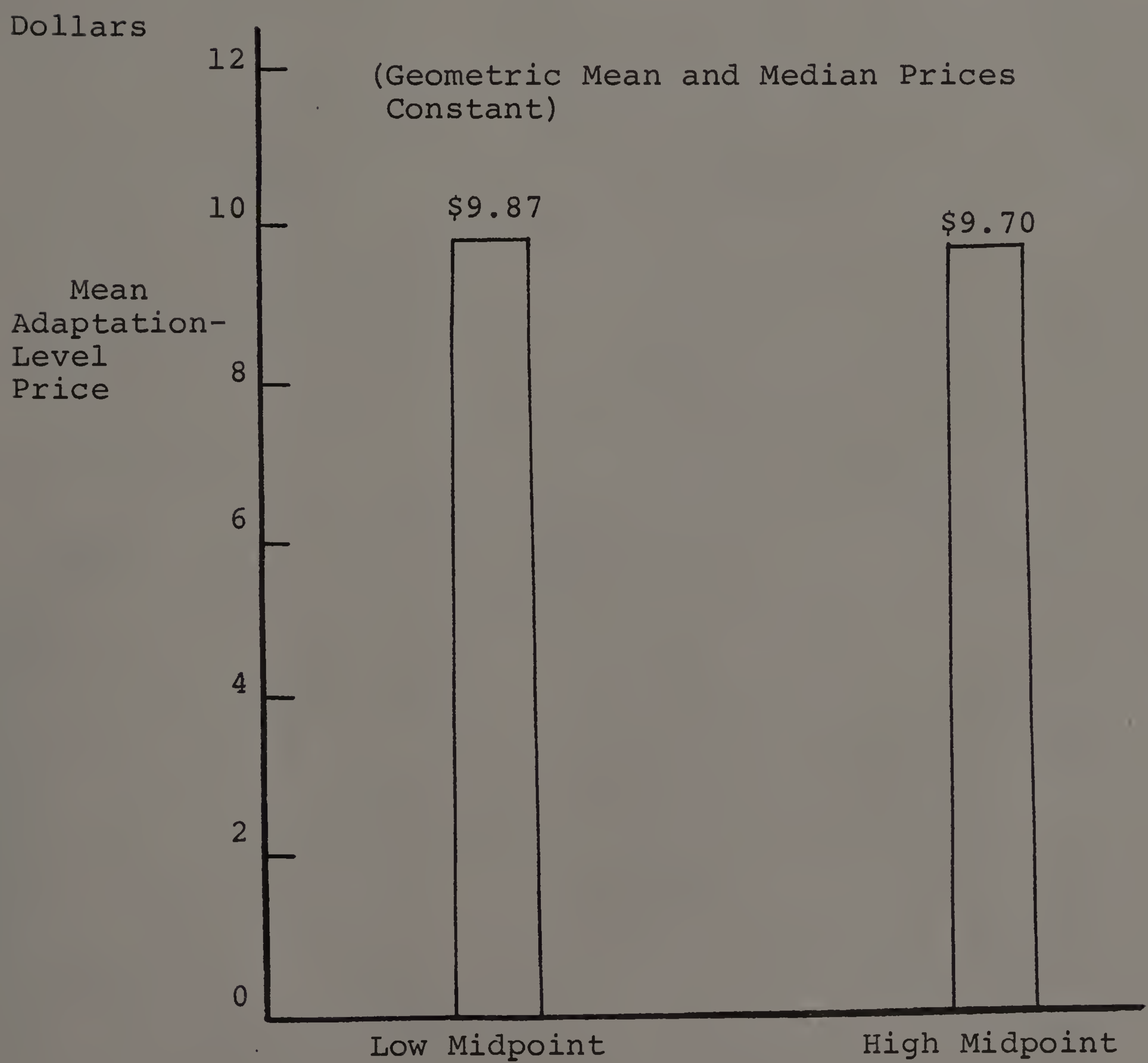


$t = -1.453$ $df = 46$

$p = 0.08$ (one-tailed)

Figure 8

MEAN RESPONSE LEVELS FOR TREATMENT CONDITIONS
OF LOW AND HIGH MIDPOINT FOR CLOCK PRICES

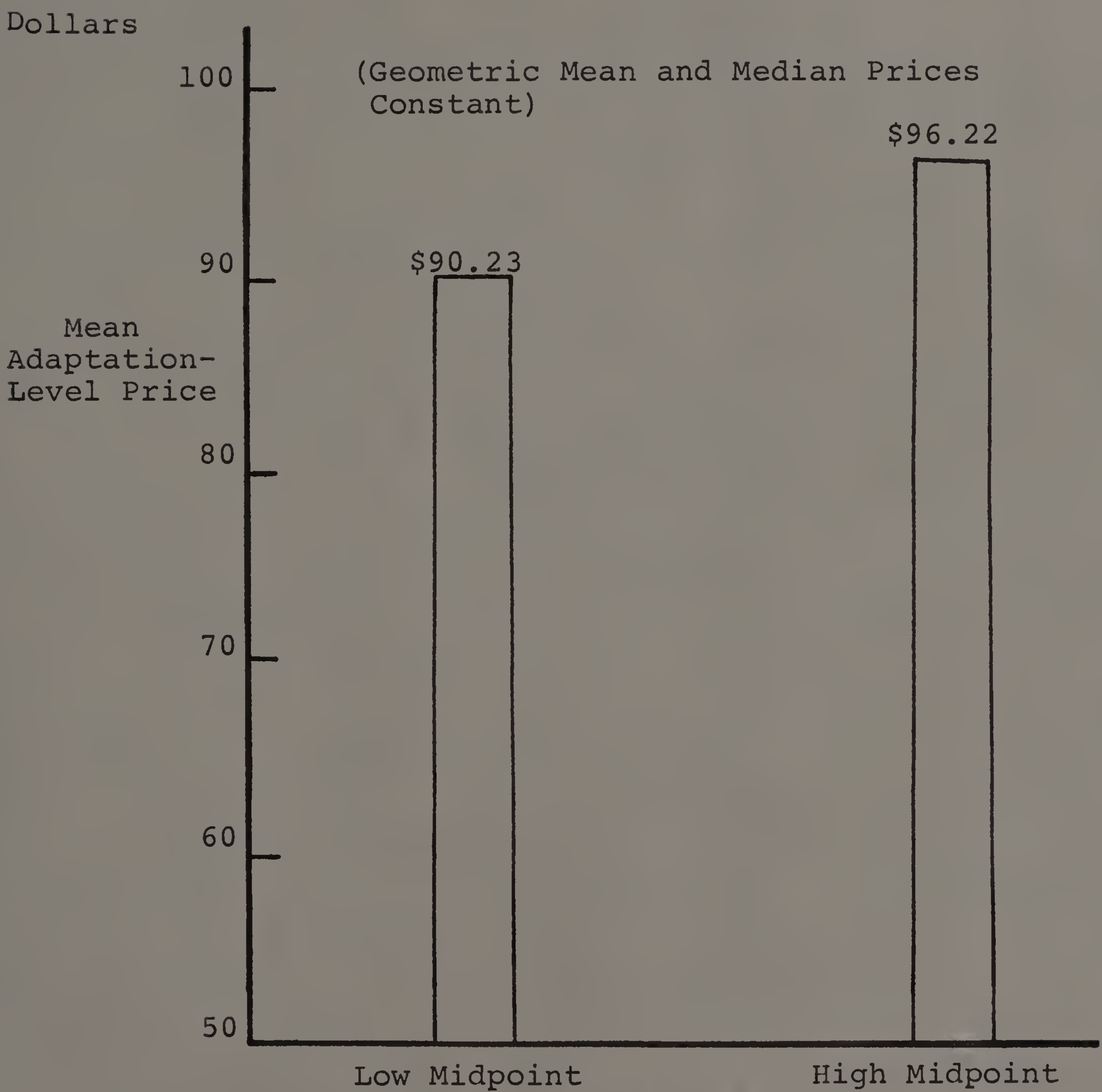


t = -0.226 df = 46

p = 0.41 (one-tailed)

Figure 9

MEAN RESPONSE LEVELS FOR TREATMENT CONDITIONS OF LOW AND HIGH MIDPOINT FOR BICYCLE PRICES



t = 1.438 df = 46

p = 0.08 (one-tailed)

Table 10

ANALYSIS OF VARIANCE TABLES FOR TREATMENT CONDITIONS OF LOW AND HIGH MIDPOINT OF THE PRICE SETS

BALLPOINT PEN

Source	SS	df	MS	F	F Prob.
Treatments (between groups)	0.247	1	0.247	2.110	0.153
Error (within groups)	5.389	46	0.117		
Totals	5.636	47			

CLOCK

Source	SS	df	MS	F	F Prob.
Treatments	0.342	1	0.342	19.61[a]	>0.10
Error	308.274	46	6.702		
Totals	308.616	47			

BICYCLE

Source	SS	df	MS	F	F Prob.
Treatments	429.824	1	429.824	2.069	0.157
Error	9557.419	46	207.770		
Totals	9987.243	47			

[a]F-ratio based on $\frac{\text{MS error}}{\text{MS treatments}}$, df = 46,1

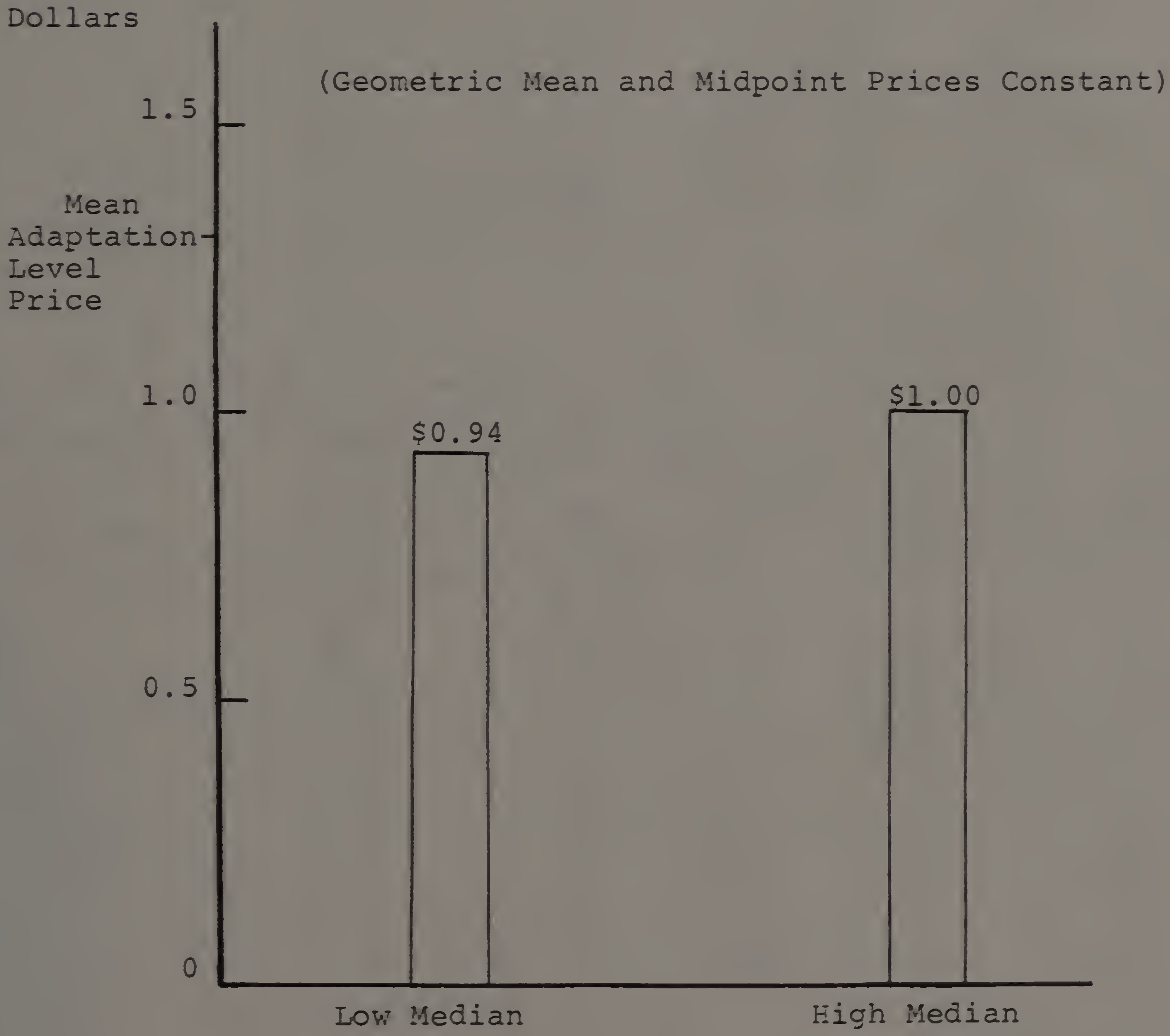
bution, the reciprocal property is used so that the F-ratio is taken as (MS error)/(MS treatments) with degrees of freedom reversed. A significant ratio would signal the possibility of some violation of ANOVA assumptions or some systematic (nonrandom) error in data collection. The ratio is not significant ($p > 0.10$).

Hypothesis 3. Hypothesis 3 states that increasing the median of a set of prices presented for judgment increases the adaptation-level price, if the geometric mean and midpoint are held constant. The null and alternative hypotheses are similar to those for Hypotheses 1 and 2. Mean AL price for "low" median treatment group and for "high" median group are graphed in Figures 10, 11, and 12. For each product category, the mean AL for the "high" median group is greater than for the "low" median group, but the t tests show that only the difference for clocks is statistically significant ($p < 0.01$ for clocks, and $p > 0.15$ for pens and bicycles, one-tailed). Thus, the data provide mixed support for Hypothesis 3. It was noted earlier that heterogeneity of variance prevailed in the data of pens and bicycles for the experimental groups used to test this hypothesis. What impact this might have had on the F tests is not clearcut.

ANOVA tables are contained in Table 11. Since the mean square treatment is less than the mean square error in the table for pens, the F-ratio is reported as (MS error)/(MS treatments). Using the reciprocal property of the

Figure 10

MEAN RESPONSE LEVELS FOR TREATMENT CONDITIONS OF LOW AND HIGH MEDIAN FOR PEN PRICES

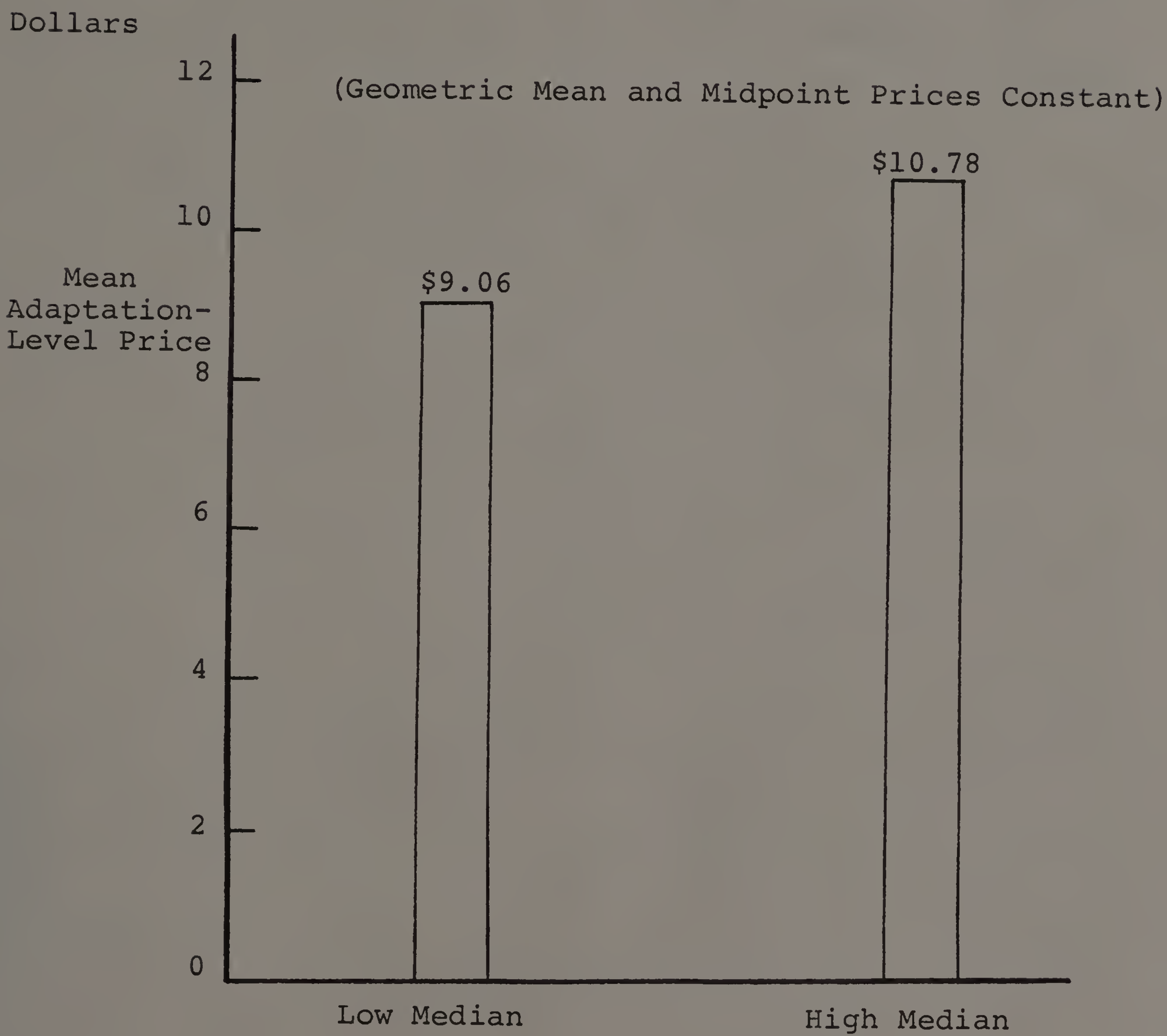


t = 0.547   df = 44

p = 0.29 (one-tailed)

Figure 11

MEAN RESPONSE LEVELS FOR TREATMENT CONDITIONS OF LOW AND HIGH MEDIAN FOR CLOCK PRICES

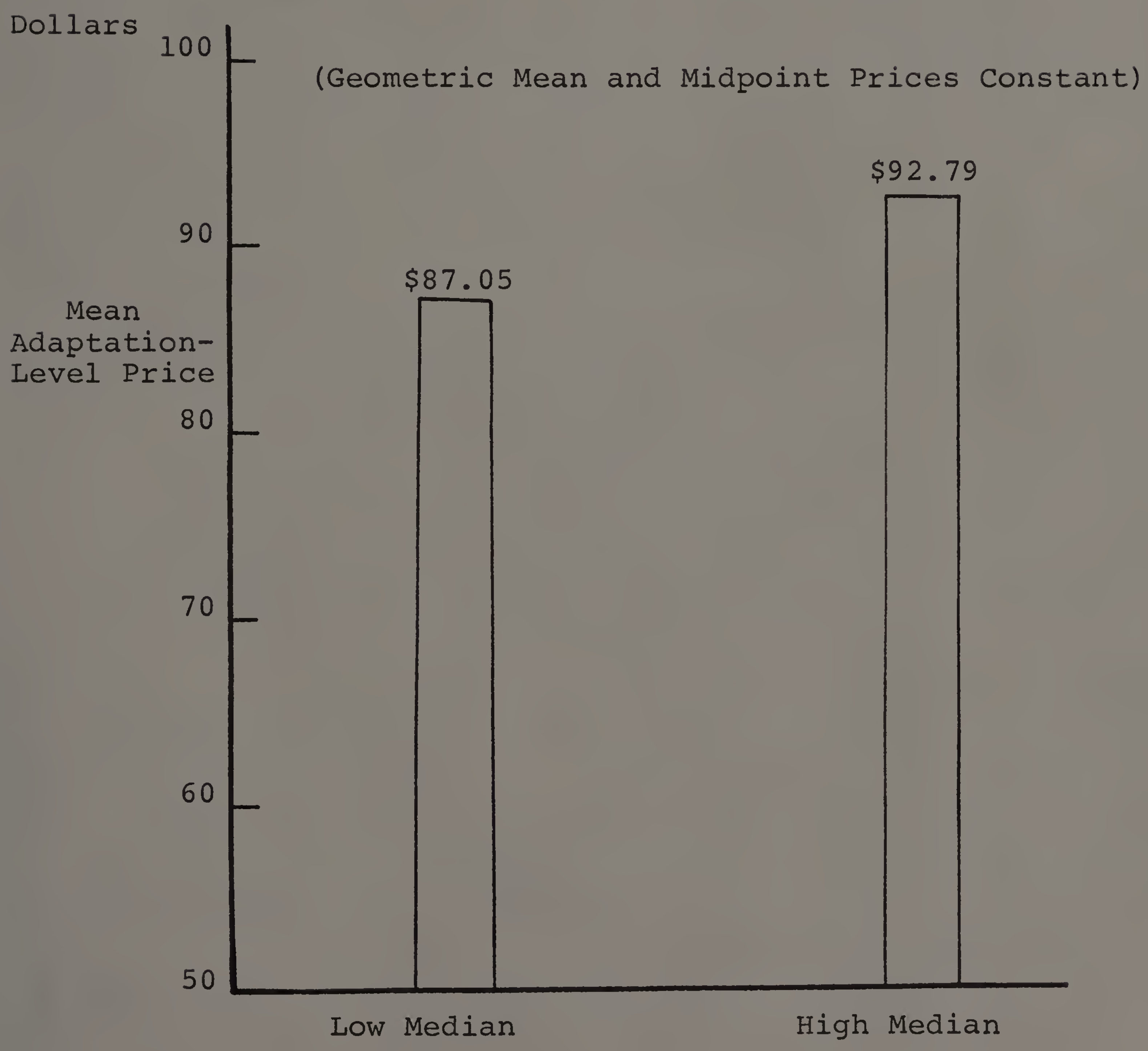


t = 2.608 df = 44

p = 0.01 (one-tailed)

Figure 12

MEAN RESPONSE LEVELS FOR TREATMENT CONDITIONS OF LOW AND HIGH MEDIAN FOR BICYCLE PRICES



t = 1.033 df = 44

p = 0.16 (one-tailed)

Table 11

ANALYSIS OF VARIANCE TABLES FOR TREATMENT CONDITIONS OF LOW AND HIGH MEDIAN OF PRICE SETS

BALLPOINT PEN

Source	SS	df	MS	F	F Prob.
Treatments (between groups)	0.041	1	0.041	3.34[a]	>0.10
Error (within groups)	5.999	44	0.136		
Totals	6.040	45			

CLOCK

Source	SS	df	MS	F	F Prob.
Treatments	33.798	1	33.798	6.800	0.012
Error	218.707	44	4.971		
Totals	252.505	45			

BICYCLE

Source	SS	df	MS	F	F Prob.
Treatments	379.874	1	379.874	1.068	0.307
Error	15654.385	44	355.782		
Totals	16034.259	45			

[a]F-ratio based on $\frac{\text{MS error}}{\text{MS treatments}}$, df = 44,1.

F distribution, the usual order of degrees of freedom is reversed and the ratio is found not to be significant ($p > 0.10$), showing no systematic violation of ANOVA assumptions.

A synopsis of results on tests of hypotheses. The evidence emerging from the research is that, under controlled conditions, the geometric mean is the price parameter that unequivocally affects adaptation level, and hence, price judgments. The hypothesized increase of AL with increase of the geometric mean was supported for all three products studied. This lends support to Helson's model of AL in a pricing context (see equation (1-7), page 14).

The hypothesized effect of the median price was supported only in the case of clock prices, while the hypothesized effect of the midpoint received no support at all. Yet the midpoint and median are crucial in Parducci's range-frequency hypothesis in explaining shifts in AL when stimuli are judged (see page 7). Our price data do not support the Parducci model.

Instead of linking the highest price and the lowest price (used to define the midpoint price) as well as the median price to Parducci's hypothesis, it might be useful to consider them as contextual variables in Helson's AL paradigm. That is, the lowest price, the median price, and the highest price might be more conspicuous to a buyer and hence have a special effect on AL in addition to their contribution to the geometric mean. This view was advanced when regression models were proposed in Chapter II, and there is supporting evidence to be presented in the next major section of this chapter on regression results.

Regression Equations Fitted

Groups 7 to 10 in the design were added to provide the necessary data to derive estimating equations. Data of these four groups were pooled with the data of the six groups used in the tests of hypotheses to obtain a maximum of 233 individual cases used to estimate the equations. In the SPSS stepwise regression program used, every case for which a variable value was declared as missing was deleted.

Helson model. According to equation (2-1) and (2-2) of Chapter II, the AL is a multiplicative function of the geometric mean price (overall contribution of the focal stimuli), the lowest price, median price and highest price (contextual stimuli), and the buyer's expected price (residual stimulus). Six cases were deleted due to missing expected price measures for pens, five for clocks, and four for bicycles. Therefore, log (AL) versus logarithm of the above variables was fitted using 226,229, and 228 individual cases, respectively. Independent variables (regressors) were included in the step-wise program up to an α-level of 0.10 (2-tailed). The equations obtained were:

PEN

$$\text{Log (AL)} = -0.174 + 0.791 \text{ Log (GM)} + 0.201 \text{ Log (EP)} - 0.112 \text{ Log (LP)} \quad (4\text{-}2)$$

CLOCK

$$\text{Log (AL)} = 0.382 + 0.273 \text{ Log (EP)} + 0.322 \text{ Log (GM)} + 0.204 \text{ Log (MD)} \quad (4\text{-}3)$$

BICYCLE

$$\text{Log (AL)} = 1.674 + 0.084 \text{ Log (EP)} + 0.505 \text{ Log (GM)} + 0.288 \text{ Log (LP)} - 0.378 \text{ Log (HP)} + 0.196 \text{ Log (MD)} \quad (4\text{-}4)$$

The abbreviations for the regressors are explained by the key in Table 12 (p. 95).

Table 12 provides the full regression data, showing the proportion of variance of the dependent variable explained (R^2), the variables included in the equation and their regression coefficients, t values and probabilities testing the significance of each coefficient, and, finally, the "beta coefficients" that indicate the relative importance of each regressor in the equation. Since the logarithmic transformation was made on both the regressand and the regressors, R^2 values are measuring the proportion of variance of log (AL) explained. To get the equivalent R^2 explaining variance in AL, a procedure suggested by Goldberger was used [6, p. 217].

Table 12

RESULTS OF REGRESSION EQUATIONS TO PREDICT THE LOGARITHM OF ADAPTATION-LEVEL PRICE (HELSON MODEL)

PEN

R^2 0.344	Regres- sor	Regr. Coeff.	Std. error	t	df	p	Beta Coeff.
	Log (GM)	0.791	0.102	7.734	223	0.000	0.476
Intercept	Log (EP)	0.201	0.030	6.673	223	0.000	0.364
-0.174	Log (LP)	-0.112	0.033	-3.404	223	0.001	-0.208

CLOCK

R^2	Log (EP)	0.273	0.030	8.987	225	0.000	0.475
0.383	Log (GM)	0.322	0.116	2.778	225	0.006	0.223
Intercept	Log (MD)	0.204	0.100	2.036	225	0.043	0.162
0.382							

BICYCLE

R^2	Log (EP)	0.084	0.018	4.608	222	0.000	0.285
0.177	Log (GM)	0.505	0.188	2.692	222	0.008	0.250
Intercept	Log (LP)	0.288	0.095	3.016	222	0.003	0.211
1.674	Log (HP)	-0.378	0.158	2.391	222	0.018	-0.220
	Log (MD)	0.196	0.109	1.797	222	0.074	0.137

Key:
GM is the geometric mean of the price set
LP is the lowest price of the set
MD is the median price of the set
HP is the highest price of the set
EP is the price the buyer expects to pay

First, the estimated values of log (AL) were computed for each individual case using equation (4-2), (4-3), or (4-4). Antilogs of these values were taken to obtain the equivalent computed AL for each individual. Finally, these computed AL's provided the data for the independent variable in a new simple regression with the observed AL's as data for the dependent variable. The R^2 values obtained were 0.29 for pens, 0.41 for clocks, and 0.20 for bicycles. When compared with R^2 values for log (AL) in Table 12, it is seen that in going from log (AL) to AL, R^2 decreases by 0.05 for pens, and increases by 0.03 for clocks and by 0.02 for bicycles. All the differences are small, but the relatively greater difference for pens may be due to the greater rate of change of the logarithmic function for small numbers than for larger numbers.

Referring to Table 12 again, it is seen that the geometric mean and the expected price came into each equation with regression coefficients significantly different from zero at $p < 0.01$ or better, and the beta coefficients show that they are the two most important predictors of AL price. Of the contextual variables -- the lowest, median, and highest prices -- the lowest price came into the pen equation, the median into the clock equation, and all three variables into the bicycle equation, although the median's contribution in this case appears marginal ($p < 0.10$).

Now to interpret the signs of some of the regression coefficients. All the coefficients are positive except those for the lowest price in the pen equation and the highest price in the bicycle equation. A negative regression coefficient for the highest price variable for bicycles seems easy to explain. For students used as subjects, a bicycle is a high-cost item. Increasing the highest price of a set of bicycle prices might lead to a rejection of that price and hence result in a downward displacement of the AL price -- the price judged medium. This would be a contrast effect. Perhaps, an opposite effect might be operating when the lowest price of ballpoint pen, a low-cost item, is raised. The price judged medium would shift downward, suggesting an assimilation effect.

Parducci model. Equation (2-3) was fitted, in which AL price is a simple linear function of the midpoint price and the median price, according to Parducci's range-frequency hypothesis (see page 7). Only the median came into the equations for all three products; R^2 was between 0.04 and 0.12. The regression coefficient for the midpoint in each case was not significantly different from zero ($p > 0.10$). This result confirms the earlier evidence from the ANOVA tests that the midpoint is not a useful variable for describing our data, further casting doubt on the applicability of Parducci's model of stimuli judgment in a pricing context.

Modified Helson model. An alternative regression form was suggested: Why not try the arithmetic mean of the price sets instead of the geometric mean in the regression equations? That is, in addition to the multiplicative, nonlinear model of equation (2-1), try a simple linear model:

$$Y = B_o + B_1 \bar{X} + B_2 X_L + B_3 X_M + B_4 X_H + B_5 X_E \qquad (4\text{-}5)$$

where: Y is the adaptation-level price;

$\bar{X}$ is the arithmetic mean of the price set;

X_L is the lowest price of the set;

X_M is the median price of the set;

X_H is the highest price of the set;

X_E is the buyer's expected price;

B_i are empirical constants.

The above equation would appear to still be within the broader framework of Helson's model. Restated, it says that the AL is a function of the arithmetic mean (overall contribution of the focal stimuli), the lowest price, median price, and highest price (contextual stimuli), and the buyer's expected price (residual stimulus).

Equation (4-5) was fitted, yielding for the different products:

<u>PEN</u>

$$AL = 0.222 + 0.691(AM) + 0.197(EP) - 0.22(LP) \qquad (4\text{-}6)$$

<u>CLOCK</u>

$$AL = 0.627 + 0.377(EP) + 0.441(AM) + 0.228(MD) - 0.12(HP) \qquad (4\text{-}7)$$

<u>BICYCLE</u>

$$AL = 5.946 + 0.407(EP) + 0.187(MD) + 0.397(AM) + 0.290(LP) - 0.185(HP) \qquad (4\text{-}8)$$

Regressor abbreviations are explained by the key in Table 13 (p. 100) in which the regression outputs are detailed. The regression coefficient of each regressor in the above equations was significantly different from zero at $\alpha < 0.05$ or better.

It seems natural to contrast the nonlinear Helson model with the modified linear model using the data of Tables 12 and 13. Except for the swap of geometric mean and arithmetic mean, the respective variables that were brought into the equations for pens and bicycles were identical for both models while an extra variable -- median price -- was included in the linear model for clocks. The beta coefficients show for each product that the mean price (geometric or arithmetic) and the buyer's expected price are the most important predictors in either model. To compare the coefficients of determination (R^2), the converted R^2 values obtained earlier for the nonlinear model were used, because these properly measure the proportion of variance in AL price explained. For pens, R^2 was 0.29 nonlinear versus 0.27 linear; for clocks, 0.41 nonlinear versus 0.44 linear; for bicycles, 0.20 nonlinear versus 0.45 linear. It is seen that the proportion of variance explained for bicycles more than doubles in going from the nonlinear to the linear model, even with the same variables involved as regressors, indicating that the linear model provides a better fit to the data. Both models appear to have about the same degree of fit for pen

Table 13

RESULTS OF REGRESSION EQUATIONS TO PREDICT ADAPTATION-LEVEL PRICE (MODIFIED HELSON MODEL)

PEN

	Regressor	Regr. Coeff.	Std. error	t	df	p	Beta Coeff.
R^2	AM	0.691	0.101	6.846	223	0.000	0.400
0.276	EP	0.197	0.035	5.577	223	0.000	0.321
Intercept	LP	-0.220	0.112	-1.971	223	0.050	-0.115
-0.022							

CLOCK

	Regressor	Regr. Coeff.	Std. error	t	df	p	Beta Coeff.
R^2	EP	0.377	0.036	10.420	224	0.000	0.525
0.440	AM	0.441	0.119	3.701	224	0.000	0.356
Intercept	MD	0.228	0.083	2.738	224	0.007	0.210
0.627	HP	-0.120	0.058	-2.079	224	0.039	-0.182

BICYCLE

	Regressor	Regr. Coeff.	Std. error	t	df	p	Beta Coeff.
R^2	EP	0.407	0.034	11.808	222	0.000	0.598
0.449	MD	0.187	0.076	2.477	222	0.014	0.151
Intercept	AM	0.397	0.142	2.792	222	0.006	0.228
5.946	LP	0.290	0.130	2.228	222	0.027	0.136
	HP	-0.185	0.083	2.215	222	0.028	-0.176

Key:
AM is the arithmetic mean of the price set
LP is the lowest price of the set
MD is the median price of the set
HP is the highest price of the set
EP is the price the buyer expects to pay

and clock AL prices.

Further considerations of obtained equations. First, could more variables be considered so as to improve the predictions? Within the framework of Helson's AL model, it would appear that the residual stimuli, which refer to variables unique to the responding subject, could be expanded in number. So far in the derived equations, the price the buyer expects to pay was the only residual variable tried in the belief that it would capture not only the buyer's previous experience with the prices of the product, but also the buyer's current and future expectations regarding price. Data for sex and price awareness were obtained in the study, and both are potentially residual variables. Since products were chosen whose prices supposedly appealed to both sexes equally, and price awareness should be captured in the expected price concept, those variables were *a priori* not expected to contribute significantly in the predictive equations.

To check these assumptions and to see if predictions improved, anyhow, sex and price awareness were included as dummy variables in both the linear and nonlinear regression models. As usual, the α-levels for including variables was set at 0.10. The outputs showed that the dummy variables for sex and price awareness did not enter any of the equations in the logarithmic model. In the linear model, sex entered marginally for pens ($p = 0.08$); the equation for clocks was unchanged; the equation for bicycles included neither variable, while deteriorating as well (fewer variables included, lower R^2). The conclusion was to leave intact the derived equations summarized in Tables 12 and 13.

A second consideration was to modify the obtained equations to account for the grouping of subjects for whom the regressor values (price parameters) were identical. A suggestion to consider as regressors dummy variables representing group membership was therefore implemented. Whenever the group dummy variables came into any equation, they caused some of the controllable variables to be excluded, with only a moderate improvement in the proportion of variance explained. The group dummy variables were therefore not included in the analysis. Also, since the group dummy variables would take on zero values for all the subjects in the validation groups, it would be pointless including those variables in the predictive equations.

A final consideration was to inquire whether multicollinearity -- correlation of regressors -- was a serious factor in the fitted equations. Multicollinearity inflates the standard error of estimate and makes it harder to reject the null hypothesis of zero regression coefficients for candidate regressors. Correlation matrices showing the Pearson product-moment correlation coefficients between pairs of regressors are shown in Appendix E for both the Helson and modified Helson models. Many of the off-diagonal elements are quite low, especially correlations associated with the expected price (generally less than 0.20) but for each product in either model, the correlations associated with the mean price (geometric or arithmetic), the median price, and the highest price are relatively high, ranging from 0.20 to 0.81. This could be an artifact of the particular prices selected in this research, since values for those parameters could be set independently for a fixed number of prices and need not move in the same direction.

It is not clear to what extent multicollinearity was a limiting factor in the regressions. For example, the highest correlation in any of the matrices was 0.81, between the arithmetic mean price and the highest price for clock, yet both variables entered the equation with significant coefficients. On the other hand, the highest correlation for pen in the same linear model was 0.64, between arithmetic mean and median prices, but the median did not enter the equation. It was hoped that as many parameters as possible whose values could be set deliberately be included as predictors for AL price, in order to allow the price-setter better control of prices. The expected price, though an important predictor, is not directly controllable by the price-setter.

High correlations or multicollinearity among some of the independent variables suggest interactions of variables, since if two variables move together (correlation) the effect of one may depend on the level of the other (interaction). It was thought that by explicitly including interaction terms among the regressors, the predictive equations might be improved in terms of proportion of variance explained. Therefore, the first-order interaction terms of the form $X_1.X_2$ for the linear model and $\log X_1 + \log X_2$ for the nonlinear model were considered. Altogether six first-order interaction terms involving four parameters -- the mean price (geometric or arithmetic), lowest price, median price, and highest price -- were included as potential regressors in either model. As usual, the F ratio for inclusion of any regressor was set in the stepwise procedure so as to lead to an α-level of 0.10 or better for the significnace of the slope.

The regression outputs showed poorer predictions with interaction terms included. Typically, the expected price came into the equation, followed by one interaction term; the main price parameters were excluded; the R^2 value was less than its former level. Once again, the conclusion was to leave unchanged the results summarized in Table 12 for the non-linear model and in Table 13 for the linear model.

Validation of Regression Models

In accordance with the research design, the data of Groups 11, 12, and 13 were used to attempt a validation of the regression equations fitted with the data of Groups 1 to

10. It will be recalled that Groups 11 to 13 judged actual market prices taken from retail stores in the Amherst area. The question posed is: How well does the derived equation predict the AL prices of subjects faced with "real life" prices? The data from each of the three validation groups were analyzed separately, so that the predictive equation for each product was tested three times. In addition, the three test groups were combined into one large sample to obtain a fourth test for each product. Derived equations based on the Helson model (nonlinear) and the modified Helson model (linear) were tested to gain further insight into the differences between those two models.

Now the validation procedure will be illustrated, using a derived equation of the Helson model for ballpoint pens to predict the AL price of subjects in group 11. First, each subject's predicted AL price was computed by substituting the logarithm of the subject's expected price and group 11 price parameter values into equation (4-2), and then taking the antilog. Next, these computed AL's provided the data for the independent variable in a simple linear regression in which the observed AL's were the dependent variable measures. Since data were available for sixteen subjects in group 11, there were sixteen data points in the regression fit. In this group, the overall fit was significant ($p < 0.05$), and R^2 was 0.26.

How good was this result? One answer might come from comparing the present R^2 with the value obtained while deriving the original predictive equation. Since the logarithmic model is involved, the "converted" R^2 is relevant, that is, the R^2 obtained precisely as described above while using the data of subjects involved in deriving the initial equation (groups 1 to 10). That value was 0.29. When compared with 0.26 from the validation, it is seen that, in this instance, the pen equation did nearly as well in predicting Group 11 AL prices as it did in its derivation; R^2 "shrinkage" was small. Shrinkage of R^2 almost always occurs when one applies a set of weights derived in one sample to the predictor scores of another sample and then correlates these predicted scores with the observed criterion scores [10, p. 282]. In the above example R^2 shrank by 0.03 -- the difference of 0.29 and 0.26.

The above validation procedure was repeated for each product by using the data of each test group and a linear or nonlinear predictive equation. Thus, predicted AL values were obtained by using equations (4-2) to (4-4) for the nonlinear model and equations (4-6) to (4-8) for the linear. Full results of the validation process are displayed in Table 14. In addition, R^2 values obtained from the original predictive equations for the linear model and "converted" R^2 values for the nonlinear model are shown in the table in order to compare with R^2 measures from the validation procedure.

Table 14

RESULTS OF VALIDATION TESTS OF DERIVED PREDICTIVE EQUATIONS FOR ADAPTATION-LEVEL PRICE

Helson Model (Nonlinear)

	(1) Test Group	(2) N	(3) F	(4) F Prob.	(5) R^2 (test)	(6) R^2 (original)
	11	16	4.83	0.05	0.26	
PEN	12	17	16.12	0.00	0.52	0.29
	13	17	1.86	0.19	0.11	
	All	50	21.17	0.00	0.31	
	11	16	4.96	0.04	0.26	
CLOCK	12	17	3.47	0.08	0.19	0.41
	13	17	1.83	0.20	0.11	
	All	50	66.28	0.00	0.58	
	11	16	27.09	0.00	0.66	
BICYCLE	12	17	10.27	0.01	0.41	0.20
	13	17	109.30	0.00	0.88	
	All	50	28.58	0.00	0.37	

Modified Helson Model (Linear)

	Test Group	N	F	F Prob.	R^2 (test)	R^2 (original)
	11	16	3.73	0.07	0.21	
PEN	12	17	24.05	0.00	0.62	0.27
	13	17	2.57	0.13	0.15	
	All	50	11.15	0.00	0.19	
	11	16	4.47	0.05	0.24	
CLOCK	12	17	2.96	0.11	0.16	0.44
	13	17	1.81	0.20	0.11	
	All	50	55.86	0.00	0.54	
	11	16	25.70	0.00	0.65	
BICYCLE	12	17	7.03	0.02	0.32	0.45
	13	17	59.39	0.00	0.80	
	All	50	73.96	0.00	0.61	

Nonlinear equations. Column three of Table 14 upper shows F ratios which test the significance of the overall fit in each case. Ten of twelve cases are significant (nine at the 0.05 level and one at the 0.10 level). All four cases for bicycles are significant and so are three cases each for pens and clocks. There are no cases of R^2 shrinkage for bicycles, but two cases are observed for pens and three for clocks. Thus, AL prices for bicycles were the best predicted of the three products, with test R^2 values for the three separate test groups at least doubling their original levels. Pen AL prices were reasonably well predicted. Clock AL prices were relatively poorly predicted, with the exception of the case of the combined test groups for which predictions were quite good.

Linear equations. The results of the validation test of linear derived equations shown in Table 14 lower are very similar to those of the nonlinear equations. Eight of twelve tests for significance of overall fit are significant at the 0.05 level, one is significant at the 0.10 level, and three are not significant. Again, predictions were best for bicycles; the changes in R^2 from the original equation to the validation tests were impressive, though not as dramatic as in the nonlinear situation.

More Debriefing Results

An important debriefing question was what guidelines or criteria the subject used in evaluating the prices. Each response was analyzed to identify the distinct guidelines mentioned, which were then classified into twelve categories. Although most subjects reported using one main guideline, two or three were common. The guidelines and procedures are now listed with their frequency counts shown in parentheses:

(a) Using previous purchase experience or habits, awareness or knowledge of market prices - - - (123);

(b) Thinking of the price the subject expects to pay or is willing to pay for the item - - - (54);

(c) Considerations of product worth or importance to the individual (e.g. any pen or clock will do, but only a durable, high-performance bicycle will do) - - - (43);

(d) Budget or financial situation - - - (34);

(e) Picking a price considered medium or average and relating the other prices to it, or thinking of some medium price first - - - (24);

(f) Associating high price with high product quality, or subjectively imputing quality levels at the prices presented - - - (24);

(g) Using some notions of what is an appropriate or reasonable price for the item (including a few mentions of "standard price") - - - (21);

(h) Looking at the highest price, the lowest price, and what was perceived as a medium price and then relating other prices to them - - - (10);

(i) Looking at the highest and the lowest prices first - - - (10);

(j) First looking at the full range of prices presented - - - (8);

(k) Picking the lowest price first and working from there - - - (5);

(l) Other criteria unclassified - - - (28).

Altogether 384 guidelines were classified.[2] Not surprisingly, previous purchase experience and knowledge of market prices exerted a marked influence on the price judgments. If we add the effects of the price the subject expected or was willing to pay, a price considered appropriate for the item, and concern for the financial budget, we get a measure of the effect of what was called the "expected price" in this study. Thus, 232 of the total count of 384 (or 60.4 percent) approximately constitute the influence of the expected price concept. These combined categories, (a), (b), (d), and (g), are indications of the residual stimulus of AL theory. When the prices to be judged (focal stimuli) were mentioned, picking a medium price to which the other prices were related was high on the list of criteria. A count of twenty-four or 6.3 percent was recorded for this

[2]This number and the implied percentages are only rough estimates because of possible errors in the classifications and because some subjects might not have been articulate enough.

classification. Here is an explicit indication of support for the underlying postulate of AL theory, namely, that the stimulus judged medium is the frame of reference used to judge the stimuli set.

The median and extreme prices seemed to have received special attention, and thereby influenced the judgmental process. Combining categories (h), (i) and (k), gives a count of twenty-five or 6.5 percent. These prices were called contextual stimuli. Although the average price was mentioned, it is unlikely that any subject computed the mean price before making his judgments. The effect of the mean price (geometric or arithmetic) is a perceptual phenomenon that is not explicitly recognized by the subject.

These verbal reports are consistent with the regression and analysis of variance results. The expected price was one of the most important predictors in the regression equations; the median price, highest price and lowest price also contributed significantly to some of the equations. In the ANOVA results, the median price produced positive shifts in AL price, if not always significantly. Although the geometric mean had a powerful influence on AL, its effect was not expected to be mentioned by the subject. Besides, the verbal reports did not deal with how the subject determined the adaptation level price, but with how he judged the prices.

The last major section of the chapter deals with results that are not directly related to the effects of price parameters on adaptation-level, but are concerned with price choices made by subjects in the early part of the laboratory exercise.

Results From Price Choice Data

During the laboratory session, one of the first tasks the subject performed was to examine all the prices presented and then rank in order of preference the first three prices he would be willing to pay for the product. The objective of the task was to increase the care the subject would exercise when evaluating the prices. A second objective was to obtain data on price choices.

The data were first interpreted directly, and then analyzed using Coombs' parallelogram [5, Ch. 4]. With thirteen groups and three product classifications, a total of thirty-nine sets of data were available for analysis. The data for the three groups presented with real market prices were analyzed first.

Direct interpretation of choice patterns. In interpreting the choices directly, the objective was to identify the influence of the five factors that affect price perception:

(i) price as an indicator of cost;

(ii) knowledge of existing brands and their perceived quality levels;

(iii) price last paid;

(iv) absolute threshold effects (lowest and highest price a buyer would pay);

(v) differential threshold effects (how much price difference leads to a change of behavior).

A basic assumption of the analysis is that a buyer has an "ideal" price he would be willing to pay for a product. This price might reflect the influence of the price last paid or the desired product quality level; it is related to, but not identical with, what has been called "expected" price in this study. Of course, the notion of "ideal points" is fundamental in Coombs' theories of psychological scaling.

The first question to answer is whether the range of prices presented bracketed the subject's ideal price. If the ideal price could be approximated by the subject's first choice, then the answer would be affirmative as long as that first choice was neither the lowest price given nor the highest. A first choice at either extreme would suggest that the subject might have gone lower or higher if permitted. Seventeen subjects in each of the three groups were pooled to get fifty-one choice patterns for each product category. In our samples, the first price choice was not an extreme price in thirty-three cases each for ballpoint pens and alarm clocks, and in thirty-seven cases for adult's bicycles. At this point the analysis proceeded along two fronts: (i) to examine the possible permutations of first, second, and third choices when the prices are adjacent; and (ii) to examine choice patterns when there are gaps between the prices, that is, when some prices were skipped.

Suppose the digits '1', '2', and '3' represent the first price choice, second choice, and third choice, respectively. A permutation of the three digits gives six possible patterns. Table 15 shows these patterns as well as the number of cases by product category when the prices chosen were adjacent, and the first choice was not the highest or the lowest price of the set. As noted in the table, a pattern '123', for example, means that three adjacent prices were picked first, second, and third in ascending order. There is an underlying influence of cost considerations suggested by all six patterns in Table 15, because it appears that the subjects were unwilling to deviate from the cluster of prices involved.

Additional interpretations are now suggested for specific patterns. Pattern '123' suggests an unwillingness to go below the price represented by '1', or a desire to get a higher priced choice. This was the most common choice pattern for all three product classes. The opposite combination '321' suggests either a reluctance to go above the price represented by '1', or a desire to choose lower prices. Combination '312' may be due to unwillingness to go above the price of '2' or a desire to get a bargain at '3'. The

Table 15

CHOICE PATTERNS AND NUMBER OF CASES BY PRODUCT CATEGORY WHEN PRICES CHOSEN ARE ADJACENT

Choice Pattern	Pen	Clock	Bicycle
123	9	15	18
321	4	3	3
312	3	4	4
213	2	2	4
231	1	1	1
132	0	0	1
Totals	19	25	31

Notes (1) Cases included only those when the price chosen first was not the highest or the lowest price given (33 for pens and clocks each, 37 for bicycles).

(2) Pattern '123', for example, means that some price was chosen first, the next higher price second, and the next higher price third.

converse, '213' suggests either aversion to a price below '2' or a wish to trade up to a price at '3'. Admittedly, these interpretations are quite speculative.

Patterns '132' and '231' were represented by not more than one case for any product category. They suggest that, after making the initial choice, the subject found a price at '2' attractive but was unwilling to go higher or lower, respectively.

So far we have considered adjacent prices, but choice patterns showing gaps or skipped prices also suggest interesting effects. Although product brands were not identified, the use of real market prices might have suggested the brand(s) sold at a given price (e.g., BIC ballpoint pen at 19 cents). Skipping prices, therefore, might indicate a knowledge of particular brands at prices skipped to - - a higher perceived quality brand at a higher price, or a perceived good offer at a lower price. Alternatively, differential threshold effects may be at work in the sense that prices in between are lumped together. In the pooled samples of fifty-one subjects each for the product classes, the number of cases showing gaps in response patterns were twenty (39%) for pens, and eight (16%) each for clocks and bicycles. These percentages might mean that the students were less concerned about the cost of ballpoint pens than they were for alarm clocks and bicycles, because there was less clustering about the first choice for pens.

To summarize the results so far, it seems that cost considerations and absolute threshold effects were predominant influences, although brand quality and differential threshold effects were discernible. If cost considerations and absolute threshold effects were the only influences working in the price rankings, then the subjects could be ordered on a "low-high" price continuum or scale. To formally check this contention and compare with results already obtained above, Coombs' parallelogram analysis was performed on the data.

Coombs' parallelogram analysis. Briefly, Coombs' method is used to construct ordinal scales from data of the kind 'pick k/n' and 'order k/n', where k is the number of stimuli to be picked or ordered, and n is the number of stimuli presented. The underlying assumption of parallelogram analysis and the related unfolding theory is that stimuli can be ordered in one dimension, and each individual or judge has an "ideal" point on that dimension such that the stimulus closest to the ideal point is the most preferred. In general, preference decreases with distance of stimuli from the ideal point. This means that stimuli and individuals can be ordered on a joint unidimensional scale (called J scale).

The initial data input to a parallelogram analysis is a matrix in which the columns are the stimuli, the rows are the individuals, and the matrix elements are marks indicating stimuli picked together ('pick k/n') or digits indicating order of choices ('order k/n'). A rearrangement of the columns and rows is sought that will make the matrix elements form a solid diagonal band (a parallelogram) across the data matrix. If the parallelogram pattern can be found, the hypothesis that the stimuli and individuals may be represented by points on a common unidimensional J scale is supported.

Real data rarely give perfect patterns. A measure of deviation from a perfect scale, and one which is regarded as a very crude measure at that, is reproducibility, which is simply the percentage of the choices that are reproduced by the scale. This index was first introduced by Guttman [7] to indicate deviations in scalogram analysis. When applied to price, it is seen that there is no need to scale the stimuli, since prices on a "low-high" dimension are ratio scaled. Assuming that individuals have "ideal" prices they would be willing to pay for a product, the relevant question (the same question we began with) is: can we order individuals on a "low-high" price continuum to obtain a joint scale? Given three groups of subjects and three product categories, nine parallelogram patterns were prepared, but only three are shown in Tables 16, 17 and 18. In each table, the columns are the price stimuli and the rows are the different response patterns. Identical rows were collapsed together, and the number of individual cases so combined is shown on the left margin. Integers '1', '2', and

Table 16

PARALLELOGRAM PATTERN FOR 'ORDER 3/9' PEN PRICES: GROUP 13

Stimuli (Prices)

Response Patterns	$0.25	0.29	0.39	0.59	0.69	0.88	1.00	1.19	1.50
5	1	2	3						
1	3	2	1						
*1	2	3					1		
2		1	2	3					
*1			2	3	1				
1			3	1	2				
1			3	2	1				
1			1			2		3	
1				1		2	3		
1					1	2		3	
1						3	2	1	
1							3	1	2
17									

Reproducibility = 100(1 - 6/17) = 64.7%

*Inadmissible pattern, according to parallelogram theory

Table 17

PARALLELOGRAM PATTERN FOR 'ORDER 3/15' CLOCK PRICES: GROUP 13

Stimuli (Prices)

Response Patterns	$2.99	4.19	4.59	4.77	5.77	6.49	7.98	8.49	9.25	9.49	9.98	10.95	11.95	14.77	16.77
3	1	2	3												
1		1	2	3											
1		3	1	2											
1		1		2		3									
*1		1			3	2									
3			1	2	3										
1			3	1	2										
2				1	2	3									
1				3	1	2									
1				3	2	1									
					X	X	X								
1						3	2	1							
1							3				1		2		
17															

Reproducibility = 100(1-3/17) = 82.4%

*Inadmissible, according to parallelogram theory

Table 18

PARALLELOGRAM PATTERNS FOR 'ORDER 3/9' BICYCLE PRICES: GROUP 13

Stimuli (Prices)

Response Patterns	$49.99	59.99	74.25	79.25	79.99	85.50	98.95	105.50	135.50
2	1	2	3						
1	2	1	3						
1	1	2		3					
		X	X	X					
4			1	2	3				
1			3	1	2				
1				1	2	3			
1				2	1	3			
*1				2	3	1			
2					1	2	3		
1						3	2	1	
1							2	1	3
1							3	2	1
17									

Reproducibility = 100(1-2/17) = 88.2%
*Inadmissible, according to parallelogram theory

'3' in the table indicate the first price choice, second choice, and third choice, respectively. For example, '1' in cell (i, j) means that subjects whose pattern is in row i made price j their first choice. Some of the missing patterns are identified by three adjacent X's and are inserted where they would be if a perfect parallelogram were to be realized.

For 'order k/n' data the number of possible response patterns is [5, p. 77]:

$$T = 1 + nk - k(k + 1)/2 \qquad (4\text{-}9)$$

where T is the number of possible patterns when k stimuli are to be ordered from n given. The number of prices given to our groups varied between nine and fifteen; thus, the total number of possible response patterns varied between twenty-two and forty, according to equation (4-9). Since sample sizes were only seventeen each, a priori we are missing some patterns. Nevertheless, even if larger samples had been used, some patterns might still be missing if the first, second, and third price choices were not spread out over the entire range of prices given (see Table 17).

According to parallelogram theory, an overall pattern of 'order k/n' data will lead to a unidimensional joint scale if the following conditions are met: (i) there are no gaps in any row, that is, the stimuli ranked are adjacent, and (ii) the integers in any row decrease strictly monotonically to 1 and then increase strictly monotonically. In our data, therefore, the patterns '123', '213', '312', and '321' corresponding to any three adjacent prices would be in order. With three digits, two other possible permutations -- '132' and '231' -- are inadmissible. In sum, the admissible patterns with gaps and the inadmissible patterns with or without gaps would be classified as not supporting the joint unidimensional scale hypothesis.

Of the three response matrices shown, the one for bicycle prices comes closest to forming a perfect parallelogram pattern (Table 18), indicating strong influence of absolute threshold effects (point at which the first choice is made) and of cost considerations (only one gap in choices). The pattern for clock prices shows wide gaps in the upper half of the price range (Table 17), indicating a strong preference for the lower prices for that product. Reproducibility was computed as:

$$\text{Reproducibility} = 100 \times \left(1 - \frac{\text{No. of inadmissible patterns}}{\text{Total no. of Subjects}}\right) \qquad (4\text{-}10)$$

A pattern was declared inadmissible if it had gaps, or if it was '132' or '231'. Response patterns not observed and marked 'XXX' were not included as discrepancies on the assumption that if a larger sample of subjects had been used, such patterns might have emerged. However, this assumption would not be true when there appears to be a defined preference for prices at one end of the scale as in Table 17. Val-

Table 19

REPRODUCIBILITY PERCENTAGES FOR NINE PARALLELOGRAM PATTERNS

Group No.	Pen	Clock	Bicycle
11	58.8	64.7	64.7
12	52.9	100	88.2
13	64.7	82.4	88.2

ues of reproducibility are contained in Table 19 for the nine response matrices prepared. Five are relatively low -- in the range fifty percent to sixty-five percent -- and include all three cases for ballpoint pens; four are relatively high, in the range eighty to one hundred percent.

The figures are properly interpreted in the context of the respective response patterns. For example, the value of 100 percent is clearly misleading, because there was a cluster of choices for the clock prices involved within the lowest five of the fifteen prices presented ($8.50 - $11.50), with one subject's response way out in the $17 to $21 range. Therefore, the matrix does not reproduce 'order 3/15' parallelogram. Overall, the evidence suggests that, in spite of the cases of violation of the ordinal properties of the scale, individuals and prices can be represented as point on a joint unidimensional scale. The observed violations are consistent with the earlier results, namely, that factors or dimensions other than cost (low-high dimensions) influence price choices.

Summary

The results of this inquiry are detailed in the chapter. Hypothesized increases of adaptation-level price with increase of the geometric mean price, the midpoint price, and the median price, respectively, were tested with the following outcomes:

1. The effect of the geometric mean price was directionally supported and statistically significant for all three product categories studied -- ballpoint pen, alarm clock, and adult's bicycle.
2. The effect of the median price on adaptation level was also directionally supported for all three product categories, but was statistically significant only for alarm clock prices.
3. Increasing the midpoint price decreased the adaptation-level price for pens and clocks, but increased it for bicycles, none of the effects, however, was statistically significant.

The evidence supports Helson's model of adaptation level, while casting doubt on the applicability of Parducci's model of judgment in a pricing context.

Regression equations were obtained to predict individual adaptation-level prices by using a logarithmic relationship. The geometric mean and the expected price emerged as the most important predictor variables, and entered the equations for all three products. The median price, lowest price, and highest price contributed in some of the equations. Converted R^2 (proportion of explained variance in adaptation-level price, not the logarithm) ranged from 0.20 to 0.41. An alternative model fitted was a linear one in which the geometric mean price was replaced by the arithmetic mean price. The data fit was about as good as before for pens and clocks and substantially improved for bicycles.

Validation of the derived equations was attempted by using the equations to separately predict the adaptation-level prices of three groups of subjects who had judged real market prices. Equations for bicycle prices predicted quite successfully; pen equations produced good predictions; mediocre predictions were obtained with clock equations. The entire modeling approach appeared to be promising and worthy of further investigation.

Results from the debriefing questionnaire are summarized in the chapter. Responses to a question probing the guidelines or criteria used by the subjects in judging the prices revealed a strong influence of previous purchase experience, knowledge of prevailing market prices for the products, and the price the subject expected to pay or was willing to pay. There was also a clear evidence of reliance on particular members of the price set presented -- the lowest price, the highest price, and what was considered a medium price.

Data on rankings of price choices were first interpreted directly, and then subjected to a formal scaling procedure called parallelogram analysis. Direct interpretation indicated a predominant influence of cost considerations and absolute threshold effects, although brand quality and differential threshold effects appeared discernible. Evidence from the scaling procedure for clock and bicycle data provided some support for the hypothesis that individuals and prices could be represented as points on a joint unidimensional scale; violations were greater for ballpoint pen data.

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CHAPTER V

CONCLUSIONS

The last chapter of this dissertation discusses the major research findings and explores the significance and limitations of the research. The chapter concludes by suggesting additional directions for future research.

Discussion

Effects of price parameters. The research hypotheses concerning the effects of the geometric mean price, the midpoint price, and the median price, respectively, on adaptation -level (AL) price were indirectly testing the applicability of Helson's and Parducci's models of stimuli judgment in pricing. The effect of the geometric mean is derived from Helson's model and the effects of the midpoint and median from Parducci's model. (See p. 31 for definitions of price parameters.)

As reported in Chapter IV, increasing the geometric mean price significantly increased the AL price, with the midpoint price and median price held constant. This result was true for all three product types studied, hence providing strong support for Helson's model. The effect of the geometric mean is properly interpreted by focusing on the change of price structure going from low to high geometric mean. A condition of high geometric mean contains relatively higher prices than the low geometric mean condition, and this makes the subject shift his standard of what is "medium price" to include higher prices. The geometric mean is merely a surrogate measure for the combined influence or pooling of all the prices. This means that any other measure that was not controlled in the experiments, such as the arithmetic mean, which combines all the prices (in keeping with Helson's theory) could be said to be "causing" the AL to shift. It will be argued, however, during the discussion of regression results that one of the reasons Helson gave for using the geometric mean to define AL is particularly applicable in a pricing context.

When the midpoint was increased, with the geometric mean and median held constant, the AL price decreased for pens and clocks and increased for bicycles; none of the effects, however, was significant. To explain these results, it is necessary to review the way the midpoint price was manipulated, and the way the prices were presented for judgment. Following the procedure of Parducci *et al*., the midpoint was increased by raising the lowest price, and decreased by lowering the highest price. Perhaps, raising the lowest price of ballpoint pens and clocks, which are basically low-price items, produced sets of prices that were perceived to be too high by the subjects and, therefore, unacceptable. Such a situation, by producing a contrast effect, may have led to a downward shift of AL. Conversely, since a bicycle is a relatively higher-priced item, raising the lowest price would not necessarily produce a set of prices perceived to be too high. Hence there was a moderate increase of the AL.

To validate these speculations, the price ranking data were examined for the group treated with the high midpoint condition. Of 25 subjects, 14 (56 percent) made the lowest pen price their first choice), 2 (80 percent) made the lowest clock price their first choice, and only 7 (28 percent) chose the lowest bicycle price first. Clearly, there was a much greater acceptance of lower prices for pens and clocks than for bicycles. This result does not necessarily imply that the manipulation of the midpoint price levels was incorrect. Indeed, if ordinary numerals had been the stimuli instead of prices, the preference for low values would have no basis to occur. Thus, the evidence suggests that Parducci's model best applies to neutral stimuli, but not necessarily to stimuli that subjects may value or be prejudiced toward. Price is clearly a value stimulus as Sherif found (see p. 20).

In addition, it is possible that the effect of the midpoint price was dependent on the order of presenting prices. In their work, Parducci _et al_. presented numerals in ascending order, and line segments in a descending order, thereby making the end stimuli clearly visible. In the random arrangement of price cards employed in this study, the lowest and the highest prices may not have been as visible as in an ordered arrangement, and the judgmental process described by the range-frequency hypothesis may not have been operative.

When the geometric mean and the midpoint were held constant, increasing the median increased the AL for all three products, but the effect was significant only for clocks. As noted in Chapter IV, the heterogeneity of variance which prevailed in the pen and bicycle data might have affected the results. Even if the effect of the median was significant for all the products, there would still be little basis to consider it a partial confirmation of Parducci's range-frequency hypothesis, because the effect of the midpoint is crucial to that model.

In this study, the median price, the lowest price, and the highest price have been considered as contextual stimuli in the Helson paradigm, since all three prices are thought to be perceptually more noticeable, even with the random arrangement of prices. Perhaps, further justification is needed for creating contextual stimuli out of what ordinarily are the focal stimuli. In their psychophysical experiments, Helson and his co-worders usually presented the stimuli either singly for absolute judgment or in pairs (the focal stimulus and a comparison or contextual stimulus) for comparative judgment. Since all the prices were in full view while evaluations were made in this study, comparative judgments were implicitly fostered, and the more perceptually conspicuous prices would be available to be used as anchors for comparison.

Confirmation of this contention is found in the debriefing comments and in the regression results where the contextual variables contributed significantly in some of the equations. The debriefing responses reveal that some of the subjects relied on the lowest price, the highest price, and what they considered a medium price when making their evaluations. These accounted for a total frequency count of twenty-five (or 6.5 percent), according to the classification scheme adopted (see pages 109-110).

Helson's theory of adaptation level seems less falsifiable than Parducci's theory. Of necessity every stimulus must be either focal, contextual or residual in the Helson paradigm, and one only needs to properly classify the variables operating in a judgmental situation. Parducci's model, on the other hand, is describing a specific perceptual process which may be inappropriate for valued stimuli and, perhaps, for random mode of presentation as well.

Before leaving the discussion of results on the tests of hypotheses, one thing should be checked. Was the expected price evenly distributed among each pair of experimental groups compared? This variable has been shown from the regression results to be an important predictor of adaptation-level price, but since it is an organismic variable (unique to the subject), it is difficult to control. With proper randomization, there should not be a significant difference in mean expected price of some product between any pair of groups. If by chance there were, for example, a significant difference in mean expected price for ballpoint pen between groups 1 and 2, and if group 2 had a higher mean expected price than group 1, then the increase in adaptation-level price with increase in the geometric mean price would have to be reinterpreted to include the effect of differences in expected price.

Analysis of variance tests were performed on the expected price data for each product between the usual experimental group pairs (groups 1 and 2; 3 and 4; 5 and 6). Results showed that the mean expected price for each product was not significantly different between each pair of groups ($p > 0.40$, typically) except for clock prices between groups 5 and 6 ($p < 0.05$). For the one significant case, it turned out that group 5 had a higher mean expected price than group 6. Since group 5 was treated with the low median condition it means that the expected price was working against the median in affecting the adaptation level; in spite of that, increasing the median significantly increased the adaptation level for clock prices.

The overall conclusion is that the results of tests of research hypotheses need not be qualified by not controlling the expected price of the subjects for the products.

Regression equations. Equations to predict AL price were estimated using the Helson model and the modified Helson model. The differences between the two models are: (i) the geometric mean is included in the Helson model and the arithmetic mean in the modified model; and (ii) the Helson equation is a log-transformed model while the modified Helson equation is a linear model. Coefficients of determination have shown that the two models have about the same explanatory power for the pen and clock data used; but for bicycle data, the modified model more than doubles the explanatory power of the original model. (For pens, R^2 was 0.29 original versus 0.27 modified; for clocks, 0.41 original versus 0.44 modified; for bicycles, 0.20 original versus 0.45 modified.)

The R^2 values obtained are respectable in view of what is typically reported in the marketing literature when individual responses are being predicted.[1] Bass et al. have argued that low R^2 values are not necessarily bad as long as the variables included in the regression equation are all significant: "Low R^2 values imply only that the variance within cells is great, not that the relationships are weak" [1, p. 266]. This means that there is great variability in the degree of importance of the independent variables in influencing the individual dependent variable observations.

The beta coefficients show that the buyer's expected price and the mean price (geometric or arithmetic) are the two most important predictors in either the Helson model or

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[1] Values of R^2 less than 0.25 are quite common, for example, in articles published in the Journal of Marketing Research.

the modified Helson model. Thus, the expected price, which could not be explicitly brought into the experimental manipulations, has received strong validation from the regression equations. The debriefing data dealing with the guidelines used by the subjects in their price evaluations confirm the importance of this variable.

So far, the emerging evidence is that AL price is a pooled effect of the focal prices (represented by either the geometric mean or the arithmetic mean), the contextual or comparison prices (represented by the lowest price, the median price, and the highest price), and the residual price (represented by the expected price).

It is now argued that, on theoretical grounds, the geometric mean should be a better predictor of AL price than the arithmetic mean. One of the reasons Helson gave for using the geometric mean to define AL (see p. 6) is because the geometric mean increases less rapidly than does the arithmetic mean when successively larger stimuli values are added to the experimental setup, thereby reflecting the law of diminishing returns commonly observed when subjects respond to various kinds of stimuli. Now, as successively higher prices are presented to individuals, these prices are more likely to be unacceptable. It is possible that an increasing number of unacceptable prices would make the price judged medium -- AL -- to stabilize, or possibly even shift downward. Under these circumstances, the geometric mean which increases at a slower rate than the arithmetic mean would be a better predictor of AL price.

The above argument implies that the Helson model is a better theoretical model than the modified Helson model in a pricing context. Nevertheless, for practical purposes of predicting AL price, for certain products and price ranges the modified model incorporating the arithmetic mean may provide better predictions than the original model incorporating the geometric mean. As Blalock suggests [4, p. 48], the best theoretical or causal model is not necessarily the best practical predictive model. The results from this research, however, indicate that the Helson model is a slightly better predictor of AL than the modified model when tested with new data. Results of the validation tests (Table 14 of Chapter IV) show that in the three sets of data tested singly and in combination for each product, the Helson model had slightly higher test R^2 values for all three products.

The overall conclusion is that the original Helson model is better than the modified model both on theoretical and on practical grounds.

Model validation. There are two important validity issues in regression analysis. The theoretical issue is whether the relationships among the variables in the equation describe any underlying phenomena. The prgamatic question is whether the equation is a useful predictive tool, especially when faced with new data.

Both issues were considered in the modeling effort. The regression equations have a theoretical underpinning in Helson's adaptation-level theory. Further, the results of the ANOVA tests might even make modest claims to causality insofar as the geometric mean and median effects are concerned. Equations obtained were rigorously tested with "real life" prices and they generally held up well, except for the clock equations.

The remarkable increase in R^2 values from the original data for the bicycle equation to all three sets of validation data for the Helson model may be partially explained by the inclusion of all the potential regressors in that equation. In spite of having the lowest R^2 in the original equation (0.20), the bicycle equation, by having two more significant parameters than the pen and clock equations, may have been the most stable equation.

Based on the results of the validation tests, it is concluded that the overall regression modeling approach works. It has scored far more successes than failures in explaining the variance of responses to real market prices (at least when tested against itself) and the R^2 values obtained are good.

Significance

The findings of this inquiry are of significance to theory and research on price perception in particular and to buyer behavior (information processing) in general. They also have implications for planning pricing strategies and tactics, and for public policy.

Price perception and buyer behavior. This study is probably the most extensive treatment of price yet undertaken within the framework of adaptation-level theory. It provides fresh confirmation that price can reasonably be studied as a stimulus and adds to the empirical evidence of Della Bitta and Monroe (see Chapter I, p. 18) that AL is a useful variable in pricing research. By testing the Helson and Parducci models of AL in pricing, this investigation has provided additional information on the way buyers seem to compare or judge prices. Additionally, the study provides a better basis for comparing and applying these models to the study of buyer behavior; this should be welcome in view of the often heard criticism that students of buyer behavior indiscriminately borrow theories and instruments from the other behavioral sciences.[2]

A quantitative formulation of AL, such as in the predictive equations, provides a basis for a new approach in the study of assimilation-contrast effects (see Chapter I, pp.

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[2] See, for example, Kassarjian's [9] critique of marketers' applications of personality theory to buyer behavior research; Robertson and Ward [12, pp. 23-25], addressing the same general issue, have proposed some principles of borrowing.

12, 18). One major drawback so far limiting the usefulness of the concepts of assimilation and contrast is that there is no way of knowing when assimilation (acceptance) of new stimuli ends and contrast (rejection) begins. Yet Parducci and Marshall (see Chapter I, p. 12), using small weights as stimuli, have found that assimilation-contrast effects are consistent with AL theory, and such effects can be explained as due to shifts in AL. If that is true with price, then the instances of assimilation and contrast found by Sherif (see Chapter I, p. 20), might be due to shifts in AL price. If similar studies are done in the future using various sequences of price sets, predictive equations for AL, like the ones obtained in the present research, may be used to estimate which configurations of prices will lead to assimilation or contrast.

The concept of expected price introduced in this study received strong validation both in the regression equations and in the debriefing responses. As reviewed in Chapter I, various researchers have used similar concepts such as "fair price," "standard price," and "price last paid." With the exception of Gabor and Granger (see Chapter I, p. 15) who related the "price last paid" to the peak of their buy-response curves, it seems that no other researchers have explicitly incorporated the variable in their theory. Kamen and Toman [7,8] who proposed a "fair price" theory[3] do not report measuring the fair price, and it does not appear in their regression equations. One is left to assume that the reason buyers switch from Majors' gasoline brands to Independents' brands when prices go up is because the fair price (which is not specified) has been exceeded.

The expected price may replace the price last paid in the buy-response function of Gabor and Granger without changing that theory. It may be possible to include the expected price in the regression equations of Kamen and Toman to predict buyers' attitudes to prices of gasoline. Again, the reason the expected price is being put forward is that it seems to not only account for previous price experience or knowledge of prices, but also includes expectations of price changes such as during periods of price inflation.

The evidence revealed in this investigation that judgments of price can be changed by shifting the price sets should be taken into account when researchers design pricing experiments involving simultaneous presentation of more than one price. For example, in Olson's review of eighteen price-quality studies (ref. 17 of Chapter I), one study used eight price levels, two studies used six prices each, and the rest

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[3]According to the "fair price" theory, consumers have preconceived ideas about what is a fair price for a given item, and are willing to pay this price or below [8, p. 27].

used four or fewer prices. For a given product, the perceived quality rating at a particular price may depend on what other prices are presented and not merely on how high or low the price is in absolute terms.

The evidence uncovered here may provide useful input for building more complete behavioral models of price that combine the several streams of inquiry in pricing. With its focus on how buyers evaluate prices per se, the AL approach may provide a basis for combining the price series with the value series (perceived quality). The need for an integrative model is echoed by Monroe's [10, p. 77] observation that it is difficult to postulate appropriate hypotheses regarding purchase response, given the interactions of the various meanings buyers impute to price.

The AL paradigm utilized in this study may make a conceptual contribution in the efforts to build buyer information processing models, especially the type that describes a buyer's cognitive processes at the point of purchase (e.g., the work of Bettman [2,3]). On a conceptual level, all the product cues could be classified into focal, contextual, and residual cues. Focal cues would be all the cues embodied by the brand such as color, size, and package printed information (including price); contextual cues would be background information such as from a salesman, a fellow shopper or displayed promotional material; and residual cues would be everything the buyer remembers about the brand from previous purchase and use or from prior exposure to advertising. Perhaps these areas could be integrated to determine a temporary "normative" brand which would form a basis for understanding and describing the choice processes among the alternative product offers.

Writing on a similar vein, Olson (ref. 17 of Chapter I) has proposed a dichotomy, "Intrinsic - Extrinsic" for classifying product cues. Intrinsic cues are derived from the actual physical product (e.g., taste in the case of beer), and extrinsic cues are product-related attributes not actually a part of the physical product, such as price. It appears that this dichotomy is too rigid for describing the cues in certain decision situations. To illustrate, in the purchase of men's cologne, the scent is rigidly an intrinsic cue in Olson's terms, but in the trichotomy suggested above, it will be a focal cue if the buyer can open the jar and sniff or if a "scratch-and-sniff" strip is attached to the package, and will be a residual cue if the buyer has to rely on his previous experience of smelling the product.

Developing pricing strategies. The regression modeling and validation effort in this study was directed toward making the findings relevant to the marketing practitioner. Price is perhaps the decision area of the marketing mix in which behavioral research has had the least input. In spite of the increased pricing research activity in recent years, cost-based pricing strategies are still dominant among businesses.

Perhaps it is appropriate to explain at this point why the price-setter should be interested in a model to predict the price judged medium (AL). First, there is no model currently available that can predict how each price in a set of prices is judged by the relevant market segment; the AL approach may be a starting point. Second, the AL gives useful information because, by definition, prices above AL are judged high and prices below AL are judged low to varying degrees depending on the distance from AL on the price scale. Depending on how the price-setter wants buyers to perceive the prices of his brands, he may then set the prices at, below, or above, the AL. More important, the predictive model gives the manager a tool by which he may attempt to control the position of the AL price in the price structure -- and managers like variables they can manipulate.

To illustrate, consider ballpoint pen prices. Suppose seven brands of ballpoint pen are competing at a given point in time in a given geographic market; the pen prices are shown in Figure 13 (left-hand side) arranged in ascending order from the bottom for clarity, even though our results hold for random arrangements. A new competitor now wishes to enter the market. He conducts consumer research to derive a predictive equation for AL, and let us suppose he finds it to be equation (4-2) which includes the geometric mean price, the expected price, and the lowest price as predictors. He

Figure 13

HYPOTHETICAL PRICE STRUCTURES FOR BALLPOINT PENS

Initial Price Structure With Seven Brands	Final Price Structure With Two Additional Brands
$1.98	$1.98
$1.79	$1.79
$1.50	$1.50
$0.98	$0.98
	$0.79
$0.49	$0.49
$0.29	$0.29
$0.19	$0.19
	$0.10

computes the AL price implied by the price configuration of Figure 13 (left). The geometric mean is known, the lowest price is \$0.19, and for expected price he could take the median expected price or the mode (most frequently occurring price) from the data of the subjects used in the research.

The new competitor proposes to introduce two brands at \$0.10 and \$0.79, and this will change the price structure (right-hand side of Figure 13). The geometric mean is now computed using nine prices, the lowest price has shifted down to \$0.10, the expected price is unchanged, and AL is recomputed using equation (4-2). If the price-setter is satisfied that the estimated price judged medium is where he would like it to be in relation to his two prices, he stops the analysis, otherwise he tries another pair of prices and repeats the process. Obviously, the latitude he has for trying different prices is related to the projected costs of production.

If the kind of analysis sketched above is viable in practice, then it may be used in a variety of pricing decisions such as:

1. Introducing a new brand in a product class. This may be a purely strategic decision; for example, the price-setter may examine the existing price structure to see if there are any price-market segments not being served.
2. Product-line pricing. The producer may wish to know how the prices of his brands are perceived in the total

group of competing brands, and locating the AL price is a help in that direction. The predictive model may also help the producer to test specific product-line pricing strategies, such as introducing an intermediate-priced brand calculated to induce the buyer to trade-up to an even higher-priced brand later. The intermediate price is chosen so that AL is shifted upward as desired. Finally, the model may help in the analysis of the impact of deleting brands from a product line. Depending on what price a deleted brand carried, there may be a major change in buyer perception of the remaining prices, and tracing the change in AL may provide useful insights.

3. Re-pricing an existing brand with little or no changes in the physical product. This may be part of an overall strategy such as introducing a new brand at a high "skimming" price and later reducing the price to achieve a deeper market penetration. The price change could also be a tactical decision to meet competitive pressures, or simply be part of routine sale pricing. In each case, the resulting AL price is related to the projected prices to see if the desired perceptual effects are obtained. For example, a projected "low" price may appear less low if the AL shifts substantially downward.

In applying the predictive model to price changes, it should be noted that the model does not explicitly deal with the magnitude of price changes, but rather looks at the final structure of prices and estimates what buyers will perceive as the new "medium" price.

It should be added that in using his derived equation, the price-setter should keep the price parameters within the range of levels used while deriving the equation. If major changes have occurred in the price structure, such as due to upward inflationary pressures, research should be repeated to estimate a new equation.

The work of Gabor and Granger which was mentioned earlier during the discussion of the expected price and related concepts, is relevant to price-setting, but differs in important respects from the present method. From the results of large-scale surveys of housewives, Gabor and Granger derived bell-shaped buy-response curves indicating the proportion of respondents who find any given price acceptable. Using this curve in conjunction with the price-last-paid curve, the price-setter may estimate the probable market response to any price he may wish to adopt.

In the method advocated here, data can be procured from relatively inexpensive laboratory experiments, although a survey approach can also be used. More importantly, while the Gabor and Granger method gives estimates of purchase probabilities at each price, our method traces changes in buyers' perceptions and only indirectly suggests the likelihood of acceptance of a price positioned above, at, or below, the AL. Furthermore, our method focuses attention on the full set of prices being charged, and it seems to be a more dynamic planning tool in the sense that the price-setter can set up any number of price structures reflecting his price moves and hypothetical competitors' moves, and the model estimates the resultant effect on AL. A buy-response curve, on the other hand, does not have this kind of integrative power. There appears to be no conflict in using the Gabor and Granger method in tandem with the method described here, except, perhaps, to replace the price last paid with the expected price. Both models provide different insights to a common problem.

The work of Kamen and Toman [7,8] briefly cited above, bears a conceptual resemblance to the predictive model described here, since it involves regression equations relating buyer attitudes and price variables. Kamen and Toman related attitudes toward purchase of Independent or Major brands of gasoline to polynomial regressions based on price level and price differential (Major-Independent) and their interactions. As stated earlier, Kamen and Toman do not incorporate the "fair price" into their equations, but the expected price is an integral part of the relationships developed here. Furthermore, the Kamen and Toman approach appears to be industry-specific: the dichotomy, "Major - Independent," is not the kind that is easily made for various product classifications. In contrast, the approach here is not industry-bound; it can be tried on any product category for which there is a reasonable number of differentially-priced brands.

Public policy. The findings of this inquiry have implications for public policy, especially on issues related to consumer protection and information. The research evidence suggests that buyers do not always compare prices on some absolute standard and what they consider a medium price may shift in response to the particular structure of the prevailing prices. In the debriefing reports, some subjects indicated using prices they considered medium as anchors in their price evaluations; certain members in this group went as far as to say they would purchase items medium-priced.

Manufacturers may succeed in pushing high prices on the consumer by making high prices the "norm," and those buyers who look for a "medium" price may in fact be paying a high price in absolute terms. Buyers should be educated on this tendency on their part. Additionally, the evidence from Doob et al. suggests that buyers tend to adapt to the structure of prices they see in the market place (see p. 16). It is therefore suggested that there be increased vigilance by public policy makers in regulating the pricing behavior of firms, for example, in oligopolies where prices tend to move together. (Compare gasoline prices in the U.S.A. since the winter of 1973.)

Limitations

Possible sources of limitations of this work are: the selection of price sets and price parameter levels, experimental directions, internal validity questions, independence of variables used as regressors, and the narrowness of the inquiry.

Selection of price sets and price parameters. The set of prices that gives any desired level of a price parameter (e.g., a geometric mean of $1.20) is not unique, even if the end prices and the number of prices are held constant. One solution to the problem, which was implemented in the design, is to be consistent in the method of choosing prices for the parameter levels being compared.

The "low" and "high" price parameter levels were arbitrarily chosen from an infinite number of possible pairs since the parameters are continuous variables. The choice of two levels is quite common in experimental work when the objective is primarily to examine whether the independent variable has any effect and in which direction [6, pp. 141-142]. It is clear that measures of AL at two parameter levels give no information on the shape, and limited information on the slope, of the function relating AL and the price parameter. In the language of ANOVA, the model employed in this study to test the research hypotheses is a fixed-effects model because parameter levels were not randomly selected from all possible values; generalization of results beyond the "low" and "high" parameter levels should be done with caution.

Experimental directions. Descriptions of products in the experimental instructions, especially for adult's bicycle, may have been vague. Some subjects commented that they were not sure whether the adult's bicycle was 3-speed, 5-speed or 10-speed. The reason the bicycle speed was not specified was because such information would have restricted the price range too narrowly to allow adequate variation of price parameter levels. Lumping together the prices of bicycles of different speeds is really what happens in a bicycle shop; it is likely that a buyer's choice of speed and price is affected by the prices of bicycles of other speeds carried by the store.

Internal validity. Internal validity asks the question: Did the treatments in fact make the difference in the dependent variable? The three experiments to test the effects of price parameters are of the type called "posttest-only control group design" by Campbell and Stanley and are strong in internal validity [5, p. 8].

The possible sources of invalidity discussed by Campbell and Stanley appear to be either controlled, negligible, or irrelevant; but one -- testing effect -- deserves specific mention here, and it will be shown that it too was controlled for. Testing refers to the effects of taking a test upon the scores of a second testing. In the experiments, each subject successively evaluated three sets of prices for the three product categories used. Some learning may have occurred as indicated in the comments of several subjects that the experimental procedures became clearer after they were performed with the first set of prices. These testing effects were controlled by having each subject evaluate the prices in the same order, so that the data compared to test the hypotheses were collected at <u>the same stage</u> in the entire procedure.

Another possible testing effect related to the successive evaluation of three sets of prices is that the order used--pen prices first, clock prices second, and bicycle prices last--was generally an ascending order of prices, which could cause lower AL prices for clocks and bicycles and hence lead to higher categories of judgment than otherwise. There are two considerations that make it unlikely that the order of price sets had any special effects on AL's. First, the individual prices within each set were not in ascending order, but rather in a randomized order. Second, there were breaks between the evaluations of the price sets when subjects performed other related tasks.

Finally, even if the order of price sets had any special effects on the AL prices of clocks and bicycles, such effects were controlled for and would not invalidate the tests of hypotheses. Again, this is because the order of price sets (or order of products) was the same for all the experimental groups, and the data used in the ANOVA were collected at the same stage in the procedure.

Independence of variables in regressions. There was some evidence of multicollinearity--high correlation of some regressors--in the estimation of predictive equations for AL. Multicollinearity inflates the standard error of estimate and makes it harder to reject the null hypothesis that regression coefficients are zero. This may have caused fewer price parameters to be included in the equations for pen and clock prices (see p. 102 for a fuller discussion and Appendix E for Correlation matrices).

The variables most correlated were the geometric mean price, the median price, and the highest price. It is mathematically feasible to set the values of these variables independently; therefore, in the derivation of the equations, prices should be selected so that these parameters do not move in the same direction from price set to price set. This approach should help reduce the correlations.

Narrowness of the inquiry. The dissertation has been concerned solely with price which, though an important product cue, is only one of many cues considered by the buyer. The effects of other cues like brand image, store image, package labelling and so forth have to be taken into account. The findings of this inquiry provide a partial understanding of the complex cognitive processes that govern buying behavior.

Suggested Directions for Future Research

Future research is suggested along the following lines: (i) to expand the scope of the inquiry to map the function relating AL to the price parameters, including study of assimilation-contrast effects; (ii) to replicate the study using product classifications with varied price structures, subjects of different socio-economic characteristics, and a serial order of price presentation; (iii) to check the sensitivity of the predictive model for AL; and (iv) going beyond price to attempt to integrate the findings into broader buyer information processing models.

Expanding the scope of the inquiry. Additional research is needed to discover the characteristics of the functions relating AL to each price parameter. This will involve using many levels of each parameter. For example, in the case of the geometric mean, it was suggested in the discussion section that increasing the geometric mean will involve introducing successively higher prices; it may happen that the AL will stabilize at some point and possibly turn downward as an increasing number of subjects find the higher prices unacceptable.

A fuller investigation of the relationship between AL and the price parameters ties naturally into the study of assimilation and contrast phenomena. Consider the case of the lowest price. If the lowest price of some product category is successively lowered, the subjects may for a while perceive it as an appropriate price for the item (assimilation), but ultimately it may be rejected as too low (contrast). As was suggested in the significance section of the chapter, the type of predictive model for AL price obtained in this study may be used to predict the transition from assimilation to contrast by noting the pattern of AL changes.

Replications to increase external validity. A start has been made to study how college students judge sets of prices for three product classifications. It is necessary to research how other buyer segments react to prices of other kinds of products and whether good predictive equations for AL can be obtained. For example, it may be that for housewives who shop regularly for groceries, the influence of the price last paid is particularly strong when they face a new set of prices for a given grocery item. In that case, the effect of the geometric mean price may be less pronounced, and in a predictive equation for AL, the expected price may be by far the most important variable. In terms of Helson's model, it means that the residual stimulus is the major determiner of AL.

For products such as men's suits which are often sold at a few price lines, the lowest, median, and highest prices may be perceptually more easily noticed by the buyer and exert great effect on AL. Since suits are infrequently purchased, the expected price may be of lesser importance in predicting the AL. For each variation of subjects and/or products, it is anticipated that the essential AL paradigm will hold, with the relative importance of the price parameters and the expected price shifting according to circumstances.

The order of presentation of prices may be varied in future studies. Since prices are rarely arranged in the market place either in a strictly ascending or a strictly descending order, it is suggested that a random arrangement be retained, but prices should be presented serially instead of simultaneously.[4] The findings of such an inquiry may then be related to the present results and to the results of Della Bitta and Monroe (reviewed in Chapter I, p. 18) in order to gain a fuller understanding of order effects of AL. A better understanding in turn may suggest strategies for displaying differentially priced product selections in various retail situations.

<u>Further checks on the predictive model</u>. It is proposed that an estimating equation for AL be obtained and subjected to many hypothetical price changes of the type sketched earlier (Figure 13), in order to examine the sensitivity of AL to the price changes. Although the regression coefficients give

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[4]Serial presentation of prices occurs in practice when a shopper walks down an aisle looking at displayed products and prices, or if the shopper rotates a revolving stand on which packaged goods are displayed.

the effect on AL of a unit change in each regressor value if the other regressors are held constant at some levels, the combined effects of simultaneous changes in the regressors need to be checked. If the AL hardly changes with what may be considered "reasonable" disturbances of the price structure, the model's usefulness may be limited. On the other hand, a volatile AL may not be a good thing.

The issue of what measure of expected price to use in forecasting AL may be explored. Should it be the arithmetic mean, geometric mean, median, or mode of the expected price of subjects used in the derivation process? The effects on AL by using the various measures of expected price should be compared.

Buyer information processing. There is need to integrate the findings on price perception here and elsewhere into the broader framework of buyer information processing. For a start, the model-builder may assume that buyers utilize cues in a sequential manner, one product cue at a time over the alternative brands; or he may assume that the buyer evaluates all the cues simultaneously, one brand at a time. For either assumption, one may explore the applicability of the AL model developed here for price; and going beyond price, the problems of cue weighting and combination will be central in the modeling effort.

Cue classification schemes, such as the trichotomy focal cue, contextual cue, and residual cue introduced earlier (see p. 142), need to be investigated further to determine their usefulness in the modeling task. This author has used that trichotomy to begin developing an information processing model including testable hypotheses [11].

In conclusion, it is hoped that the research effort detailed in this dissertation has made some contribution of value and suggested some useful leads in the quest for understanding of buyer decision processes.

Summary

In the closing chapter of the dissertation, the results of the hypotheses tested are discussed in some detail within the context of the Helson and Parducci models of stimuli judgment. The conclusion is that the data of this inquiry provide support for Helson's model of adaptation level in pricing and do not fit the Parducci model. The derived predictive equations for adaptation-level are discussed and issues of model validity -- theoretical and pragmatic -- are addressed.

Implications of the research findings are drawn for theory and research in price perception and buyer information processing, for planning pricing strategies and tactics, and for public policy.

Limitations of the study are examined. Issues touched on are related to: selection of price sets and price parameter levels; description of products whose prices were studied; multicollinearity among regressors in the predictive equation for adaptation-level price; and the narrowness of the inquiry.

Finally, new research is suggested along the following lines: to expand the scope of the inquiry to map the function relating adaptation-level price to each price parameter, including study of assimilation - contrast effects; to replicate the research to increase external validity by using products with different price structures, subjects with different socio-economic characteristics, and a serial order of price presentation; to check the sensitivity of predicted adaptation-level price under various hypothetical price structures; and to integrate the findings into broader buyer information processing models.

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APPENDIX A

PRE-TEST TO ESTIMATE PRICE LIMITS

To obtain approximate acceptable price limits or thresholds for the subjects, a method similar to that used by Sherif [8] was adopted. (For a method closer to psychophysics, see the work of Monroe and Venkatesan [2]).*

Each subject was given four sheets of paper, the first sheet containing instructions, and the subsequent three sheets containing price scales for ballpoint pen, alarm clock, and adult's bicycle, respectively. The instructions were as follows:

> Suppose you are shopping for a ballpoint pen, an alarm clock (no radio), and an adult's bicycle (not for racing). In each price scale presented below, indicate <u>one price</u> that is your best estimate by writing next to the scale:
>
> "H" for the highest price you would even think of paying for the item for your own use;
> "M" for the most acceptable price you would like to pay for the item;
> "L" for the lowest price (not $0) that you would want to pay for the item.
>
> If the price scale is not high enough or low enough for you, please write in the price.

The price scale for ballpoint pen ranged from $0.02 to $5 in two columns on the page; for alarm clock, $1 to $25 in one column; and for adult's bicycle, $15 to $190 in four columns.

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*References may be found at the end of Chapter III.

The data were analyzed by simply finding the upper quartile, median, and lower quartile for each category of price -- the highest, most acceptable, and lowest. The values are presented below.

One could define an approximate latitude of acceptance (range of acceptable prices) for the group as a whole to extend from the median lowest price to the median highest price. To widen the range, however, natural cut-off points would be the lower quartile of the lowest price and the upper quartile of the highest price.

		Lowest Price	Most Acceptable Price	Highest Price
BALLPOINT PEN	Upper Quartile	$0.20	$0.50	$5.00
	Median	$0.19	$0.43	$2.00
	Lower Quartile	$0.15	$0.32	$0.87
ALARM CLOCK	Upper Quartile	$8	$13.75	$24.50
	Median	$5	$10	$15
	Lower Quartile	$2	$5	$10
ADULT'S BICYCLE	Upper Quartile	$92.50	$127.50	$162.50
	Median	$80	$110	$147.50
	Lower Quartile	$50	$77.50	$115

APPENDIX B

SETS OF PRICES JUDGED BY VARIOUS GROUPS OF SUBJECTS

(Actual order of prices in each deck of cards)

Experiment 1: Geometric Mean Varied (Midpoint and Median Constant)

Group 1: Low Geometric Mean			Group 2: High Geometric Mean		
PENS	CLOCKS	BICYCLES	PENS	CLOCKS	BICYCLES
$0.20	$4	$52	$0.75	$9	$85
0.30	4.50	55	1.00	12	90
1.80	16	115	2.45	22.50	150
0.10	3	45	0.10	3	45
2.65	21	140	2.90	24.50	162
2.30	17.50	125	2.75	24	158
0.85	8	70	1.30	13	97
2.05	17	120	2.60	23	155
0.55	6	60	1.20	12.50	93
3.00	25	165	3.00	25	165
1.60	15	108	1.90	17	130
0.15	3.50	48	0.45	6.50	80
1.20	11.50	85	1.45	13.50	100
1.55	14	105	1.55	14	105
1.75	15.50	112	2.25	20	145

Experiment 2: Midpoint Varied (Geometric Mean and Median Constant)

Group 3: Low Midpoint			Group 4: High Midpoint		
PENS	CLOCKS	BICYCLES	PENS	CLOCKS	BICYCLES
$0.85	$9	$70	$0.70	$8	$75
1.20	10	85	0.75	8.50	77
2.10	17	123	1.70	15.50	110
0.10	3	45	0.60	7	70
2.25	18.50	132	2.60	22	140
2.20	18	128	2.25	18.50	120
1.45	13	90	0.95	9.50	82
2.15	17.50	125	1.90	16	115
1.40	12	87	0.80	9	80
2.30	19	135	3.00	25	165
1.85	16	115	1.60	14.50	103
0.45	6.50	65	0.65	7.50	73
1.50	13.50	95	1.30	11	85
1.55	14	100	1.55	14	100
2.05	16.50	120	1.65	15	105

Experiment 3: Median Varied (Geometric Mean and Midpoint Constant)

Group 5: Low Median			Group 6: High Median		
PENS	CLOCKS	BICYCLES	PENS	CLOCKS	BICYCLES
$0.45	$7.50	$75	$0.30	$4	$55
0.65	8	77	0.45	8	75
1.85	17	150	1.85	17	138
0.10	3	45	0.10	3	45
2.70	24	163	2.60	22	148
2.55	21	160	2.35	19	145
0.75	9	85	1.00	11	100
2.20	19.50	155	2.10	18.50	140
0.70	8.50	80	0.70	10	90
3.00	25	165	3.00	25	165
1.25	13	115	1.60	15.50	133
0.30	6	65	0.15	3.50	50
0.80	9.50	87	1.25	12.50	105
0.95	10	90	1.50	15	130
1.50	13.50	135	1.70	16	135

Supplementary Experimental Prices

Group 7			Group 8		
PENS	CLOCKS	BICYCLES	PENS	CLOCKS	BICYCLES
$0.65	$6.50	$55	$0.75	$4.50	$67
0.85	7	63	0.80	6	70
2.00	15	123	1.90	16	115
0.20	3	45	0.60	3	60
2.55	16.50	130	2.85	18	140
2.40	16	128	2.60	17	125
0.95	8	95	0.90	9	78
2.25	15.50	125	2.25	16.50	120
0.90	7.50	78	0.85	7.50	75
2.60	17	135	3.00	19	165
1.30	11.50	117	1.35	15	90
0.50	5	50	0.70	4	63
1.05	8.50	110	0.95	12.50	82
1.10	9	115	1.00	14	85
1.65	13	120	1.75	15.50	105

Supplementary Experimental Prices (continued)

Group 9			Group 10		
PENS	CLOCKS	BICYCLES	PENS	CLOCKS	BICYCLES
$0.50	$4	$55	$0.25	$8	$70
0.75	4.50	60	0.35	8.50	75
1.90	8.50	90	1.00	18.50	135
0.10	3	45	0.10	7	45
2.15	11.50	105	1.75	23.50	150
2.10	10	100	1.50	22	145
1.15	5.50	68	0.45	9.50	85
2.05	9	95	1.25	20	140
0.90	5	65	0.40	9	80
2.20	13	115	2.00	25	155
1.70	7.50	80	0.80	13	110
0.25	3.50	50	0.20	7.50	60
1.40	6	72	0.60	10	90
1.65	7	75	0.75	10.50	95
1.85	8	85	0.85	16	120

Market Prices

Group 11			Group 12		
PENS	CLOCKS	BICYCLES	PENS	CLOCKS	BICYCLES
$0.69	$14.95	$77.95	$0.16	$24.00	$125
1.95	13.00	79.95	0.19	21.00	150
1.50	9.49	125.00	0.87	11.50	135
0.25	17.00	49.95	1.77	29.95	130
0.98	6.98	139.95	1.67	9.95	158
0.19	7.98	134.95	0.29	10.50	110
1.98	11.95	89.75	1.37	17.50	75
0.49	8.45	129.95	0.21	10.95	89.95
0.29	12.50	85.00	1.98	20.00	115
0.39	6.15	169.95	0.49	8.50	
0.59	10.49	110.00	0.39	13.00	
	15.50	59.95	0.43	25.95	
	11.50	99.95	0.77	15.00	
	10.95	105.00		14.00	
	9.25	115.00		12.45	
Sta-tion-ery Store	University Store	Bicycle Shop	Discount Store	Jewelry Store	Bicycle Shop

Market Prices (continued)

Group 13

PENS	CLOCKS	BICYCLES
$0.69	$11.95	$79.99
1.19	10.95	105.50
1.00	5.77	98.95
0.88	16.77	85.50
1.50	4.19	135.50
0.39	4.59	74.50
0.25	9.49	49.99
0.29	4.77	59.99
0.59	9.98	79.25
	2.99	
	7.98	
	14.77	
	9.25	
	8.49	
	6.49	
University Store	Discount Store	Sears 1974 Summer Catalog

APPENDIX C

E X P E R I M E N T A L   I N S T R U C T I O N S

Part I: Instructions for Price Judgments

Please empty out the contents of the envelope and notice that there are (i) 3 sets of white cards, (ii) 3 sets of orange cards, and (iii) some rubber bands.

The Situation

Imagine that you are shopping for a ballpoint pen, an alarm clock (without radio), and an adult's bicycle (not for racing). For each product assume that: (1) the store you are at has got a wide selection; (2) each selection has the basic features you would look for in the product; and (3) each selection is marked at a different price due to differences in brands and/or features.

Procedure

Please perform the following tasks, starting with the set of white cards marked "BALLPOINT PEN":

(Check off each step as you complete it.)

A-1. Arrange the white cards from left to right facing up in the order in which they appear and in two rows so as to fit. Move them forward to line up with the tape marked "POSITION ONE" on the table. The cards represent selections of ballpoint pens carried by the store. Verify that the cards are single and no card covers another.

A-2. Examine the prices displayed. On the basis of price alone pick one card which comes closest to representing your first purchase choice for a ballpoint pen, a second card representing your second purchase choice, and a third card representing your third purchase choice.

Write down the prices on the cards:

1st choice $ ________

2nd choice $ ________

3rd choice $ ________

A-3. Untie one set of orange cards. There are 7 cards, each representing a category of judgment. Arrange them facing up immediately below the white cards to line up with the tape marked "POSITION TWO" in the following order:

EXTREMELY LOW PRICE	VERY LOW PRICE	LOW PRICE	MEDIUM PRICE	HIGH PRICE	VERY HIGH PRICE	EXTREMELY HIGH PRICE

There is now plenty of room below the orange cards.

A-4. Think of the basic needs fulfilled by a ballpoint pen. then assume that all the differentially-priced selections are comparable in the sense that each can satisfy those basic needs. Now compare the prices by taking each white card and placing it below one of the orange cards. Please do not cover the orange cards and separate the white cards when more than one is placed below a given orange card. Use as many judgment categories (orange cards) as you see fit and feel free to change your assignments. Take your time.

A-5. When <u>all the white cards</u> have been placed below some orange card, pause and reflect on your assignments. Make any further changes you feel like making.

A-6. When you are satisfied with your judgments, use one rubber band to tie each orange card together with its white cards. Ignore the unused orange cards, if any.

A-7. Put the tied cards and the unused orange cards (if any) in the envelope.

Now to repeat the above procedure using the white cards marked "ALARM CLOCK" (no radio). Please proceed:

B-1. Arrange the white cards from left to right in the order in which they appear, and to line up with "POSITION ONE". Verify that the cards are single.

B-2. Examine the prices displayed. On the basis of price alone make your first, second and third purchase choices for an alarm clock. Write down the prices on the cards:

1st choice $ _________

2nd choice $ _________

3rd choice $ _________

B-3. Arrange another set of orange cards below the white cards to line up with "POSITION TWO" in the order: Extremely Low Price Very Low Price Low Price Medium Price High Price Very High Price Extremely High Price.

B-4. Think of the basic needs fulfilled by an alarm clock and assume that the various selections are comparable in the sense of satisfying the basic needs. Then compare the prices by placing each white card below one of the orange cards. Remember, do not stack the white cards, separate them. Take your time.

B-5. When <u>all the white cards</u> have been judged, pause and review your assignments.

B-6. When you are satisfied with your judgments, tie each used orange card with its white cards, and place them together with any unused orange cards in the envelope.

Now for the final product, ADULT'S BICYCLE. Please proceed.

C-1. Arrange the white cards from left to right. Be sure no card covers another.

C-2. Examine the prices displayed and make 3 choices: Write down the prices on the cards.

1st choice $ __________

2nd choice $ __________   3rd choice $ __________

C-3. Arrange the last set of orange cards below the white cards in the usual order: "Extremely Low Price" through "Medium Price" to "Extremely High Price".

C-4. Think of the basic needs fulfilled by a bicycle and assume that the selections are comparable in the sense of satisfying those basic needs.

Then compare the prices by placing each white card below one of the orange cards. Take your time.

C-5. After assigning <u>all the white cards</u>, pause and reflect on your judgments. Make any necessary changes.

C-6. When you are satisfied with your assignments, tie each used orange card together with its white cards and place them along with any unused orange cards in the envelope.

Fold these instruction sheets and stuff them in the envelope and signal the attendant.

Here ends the major part of the exercise.

Part II: Price Limits, Expected Price and Debriefing Questionnaire

Your Comments and Other Information

1. Your sex?

2. In each price scale presented below for each product, indicate your best estimate by writing next to the scale:

   "H" for the highest price you would even think of paying for the item for your own use.

   "E" for the price you would expect to pay today if you purchased the item for your own use.

   "L" for the lowest price (not $0) that you would want to pay for the item for your own use.

If the price scale is not high enough or low enough for you, write in the price. Make only 3 marks per product.

BALLPOINT PEN

--$5.00			
-	--$2.40	--$0.78	--$0.28
-	-	-	-
-	-	-	-
-	-	-	-
--4.50	--2.00	--0.70	--0.20
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
--4.00	--1.50	--0.60	--0.10
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	--0.02
--3.50	--1.00	--0.50	
-	-	-	
-	-	-	
-	-	-	
-	-	-	
--3.00	--0.90	--0.40	
-	-	-	
-	-	-	
-	-	-	
-	-	-	
--2.50	--0.80	--0.30	

OVER

ALARM CLOCK

--$30
-
-
-
-
--25
-
-
-
-
--20
-
-
-
-
--15
-
-
-
-
--10
-
-
-
-
--5
-
-
-
--1

OVER

ADULT'S BICYCLE

--$190	--$140	--$90	--$40
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
--185	--135	--85	--35
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
--180	--130	--80	--30
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
--175	--125	--75	--25
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
--170	--120	--70	--20
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
--165	--115	--65	--15
-	-	-	
-	-	-	
-	-	-	
-	-	-	
--160	--110	--60	
-	-	-	
-	-	-	
-	-	-	
-	-	-	
--155	--105	--55	
-	-	-	
-	-	-	
-	-	-	
-	-	-	
--150	--100	--50	
-	-	-	
-	-	-	
-	-	-	
-	-	-	
--145	--95	--45	
-	-	-	
-	-	-	
-	-	-	
--141	--91	--41	

OVER

3. Please indicate the degree of your awareness or knowledge of market prices of the three products by marking "X" in one interval:

BALLPOINT PEN PRICES /__________/_______________/________________/
Not aware Slightly aware Generally aware

ALARM CLOCK PRICES /__________/_______________/________________/
Not aware Slightly aware Generally aware

ADULT'S BICYCLE PRICES /__________/_______________/________________/
Not aware Slightly aware Generally aware

4. How clear were the procedures for the exercise?

5. Please describe what guidelines you used in assigning the prices to the judgmental categories (orange cards).

OVER

6. What do you think the experimenter was trying to find out in the entire procedure?

7. How much care did you exercise in making the price judgments?

8. Any other comments?

9. This is the end. THANK YOU VERY MUCH FOR YOUR TIME AND EFFORT! Good luck in the draw.

Note: Please do not discuss any aspects of this exercise with other students. Their classes may participate in subsequent runs of this experiment. Thank you.

For the random draw

Fill in your name, address and phone on the attached slip, tear off and hand in to the attendant.

(Fold these sheets and stuff them in the envelope).

Part III: Instructions Read Aloud to the Subjects When They Were Seated in the Laboratory

You will receive an envelope and a set of instructions. As you read the instructions, please proceed to do what is asked before reading the next step. Reading ahead may lead to some confusion. Notice masking tape markings "POSITION ONE," and "POSITION TWO" on the table. (Pause). You will move the white cards up to "POSITION ONE" and the orange cards to "POSITION TWO" at the appropriate time in the procedure. Please work individually and do not talk with your neighbor. If there is any question regarding the procedures or the cards, raise your hand.

When you leave this room, please do not discuss any aspects of this exercise with other students. Their classes may participate in subsequent runs of the experiment. Thank you.

APPENDIX D

ATTEMPTED TRANSFORMATIONS TO PRODUCE HOMOGENEITY OF VARIANCE ON GROUPS 5 AND 6 FOR PEN AND BICYCLE DATA

The square root and logarithmic transformations were tried. The square root transformation:

$Y' = (Y + 0.5)^{1/2}$ was made on pen data since the numbers were all less than ten;

and $Y' = Y^{1/2}$ was made on bicycle data.

The logarithmic transformation:

$Y' = \text{Log } Y$ was made on data of both products.

In each case:

Y is the original dependent measure (AL);

Y' is the transformed measure.

For each transformation, all the three tests for homogeneity of variance -- Cochran's Max. Variance/Sum of Variances, Bartlett-Box F, and Hartley's Max. Variance/Min. Variance -- reject the equality of variance hypothesis with $p < 0.05$ for pens, and $p < 0.01$ for bicycles.

APPENDIX E

CORRELATION MATRICES FOR VARIABLES CONSIDERED IN THE REGRESSION EQUATIONS*

HELSON MODEL

		Log GM	Log LP	Log MD	Log HP	Log EP
	Log GM	1	.46	.56	.44	.11
	Log LP	.46	1	-.08	.35	.04
PEN	Log MD	.56	-.08	1	.27	.06
	Log HP	.44	.35	.27	1	.06
	Log EP	.11	.04	.06	.06	1

		Log GM	Log LP	Log MD	Log HP	Log EP
	Log GM	1	.36	.75	.80	.11
	Log LP	.36	1	.11	.36	.03
CLOCK	Log MD	.75	.11	1	.74	.02
	Log HP	.80	.36	.74	1	.11
	Log EP	.11	.03	.02	.11	1

		Log GM	Log LP	Log MD	Log HP	Log EP
	Log GM	1	.00	.57	.67	.18
	Log LP	.00	1	-.17	.33	.04
BICYCLE	Log MD	.57	-.17	1	.40	.10
	Log HP	.67	.33	.40	1	.15
	Log EP	.18	.04	.10	.15	1

*See key in Table 12 for meaning of symbols used.

APPENDIX E (Continued) Correlation Matrices

MODIFIED HELSON MODEL*

		AM	LP	MD	HP	EP
	AM	1	.21	.64	.53	.11
	LP	.21	1	-.08	.37	.11
PEN	MD	.64	-.08	1	.20	.01
	HP	.53	.37	.20	1	.08
	EP	.11	.11	.01	.08	1

		AM	LP	MD	HP	EP
	AM	1	.26	.74	.81	.06
	LP	.26	1	.09	.38	.02
CLOCK	MD	.74	.09	1	.68	-.02
	HP	.81	.38	.68	1	.07
	EP	.06	.02	-.02	.07	1

		AM	LP	MD	HP	EP
	AM	1	-.11	.56	.66	.07
	LP	-.11	1	-.18	.33	.15
BICYCLE	MD	.56	-.18	1	.34	.02
	HP	.66	.33	.34	1	.08
	EP	.07	.15	.02	.08	1

*See key in Table 13 for meaning of symbols used.

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