Cue consistency and page value perception: Implications for web-based catalog design

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ABSTRACT

The web-based product catalog is a central element of online retailing. Although the extant research has studied the effect of design elements, such as product presentation, recommendation agents, and image and text on consumer choice, little is known about how Internet vendors could distribute products in a multi-page online product catalog for better performance. It is well-known that the first page of an online product catalog is particularly important to a vendor. Based on price signaling literature and cue consistency theory, this study investigates how price and product popularity cues could be carefully designed for the first page to achieve better sale performance. This study suggests there is a delicate balance point where price cues and popularity cues can achieve consistency and synergy and lead to better page value perceptions for the first page. The boosted page value perceptions, in turn, lead to better sales from the first page. This study extends the theory of cue consistency to the product group level.

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1. Introduction

A typical web-based online catalog consists of products categorized by brand, consumer type, product type or other product attributes. For each product category, products are often displayed in a linear or matrix format in one web page or over multiple pages, depending on the number of products. From an Internet vendor’s perspective, the web-based product catalog is often the only channel for transactions. From an online consumer’s perspective, product choices are affected by not only the products but also by the information technology used to present the products [7,11,27,60,64,65]. Therefore, the design of a web-based product catalog as a key component of website design has a direct impact on consumers’ choices and on a vendor’s sales. Consequently, web-based product catalog design is increasingly of interest to both marketing researchers [38,50] and information systems researchers [11,31–34,39].

The extant literature has focused on how to use technical design elements in online catalog systems, such as using recommendation agents and auction mechanism [23], to improve consumer decision accuracy and efficiency. For example, prior studies have investigated the effect of linear and matrix display format on consumer search or browsing tasks [31–33], the spatial distribution of products in one page for better consumer attention [38], the effect of sorting or filtering on price sensitivity [48,50], the order of products in a list [17–19,60], image and text size [55], and the impact of the accessibility of product attribute information [3,27,28,34] on consumer choice. Several studies have investigated the effect of catalog design on consumer attention distribution over displayed items and price sensitivity, but the focus has been on how consumers’ product choices were modified, rather than the change in the vendor’s sales [38,48].

An important online catalog design problem, which is also a within-store marketing problem [22], is how to distribute products in one category over multiple web pages for better sales. Vendors typically have too many products in a product category to be displayed in a single web page. For example, online florists usually carry more than 20 flower arrangements for Valentine’s Day. An appliance seller would allow consumers to filter TVs by screen size and display a long list of results over pages. Such computer generated product categories are often aimed at consumers of similar need. Is it possible to distribute products of the same category more effectively over multiple web pages, an effort that costs very little, to achieve better sales? Research in offline retailing suggested that it is possible to achieve better profit through better shelf management because better shelf management can help (1) sell high profit products, (2) cross-sell complementary items, and (3) reduce out-of-stock cost [22]. Product distribution in an online product catalog can be regarded...
as the counterpart of the offline shelf management problem. However, the web-based product catalog design issue has rarely been investigated. This study focuses on the first aspect, which is to increase the vendor profit by selling higher profit products through better online shelf management.

How should vendors use the page space in an online catalog? The intuition is that high profit items should be on the first page. However, there are pros and cons to this simple solution. To simplify discussion, we assume an online product catalog has only two web pages for a product category. Product accessibility refers to the page placement of a product, that is, the first page and the second page is considered to have low accessibility, and the second page is considered to have low accessibility. The first page is of particular importance because it receives more attention than the following pages [59]. If a vendor carries products of better quality, lower price, and higher profit, such products should be displayed on the first page. Both consumers' and the vendor's welfare are increased. The crux of the problem is that higher profit items do not necessarily have low prices. Often, higher profit items are more expensive. Even when the percentage of profit is the same for two products, it is better to place the product of a higher price on the first page to increase revenue per sale. However, placing all high-price products on the first page may create an undesirable price image of the page. Consumers might search further into the following pages and choose items of a lower price or switch to other vendors. Therefore, while increasing the accessibility of high-price items may help to increase revenue per sale [22], it is not without side-effects that may ultimately neutralize the gain.

The mission is to retain consumers and to sell them items of a higher price. This mission is not impossible, however, if their quality and product value perception of first page items is also boosted. This retention of consumers is possible because consumers' purchase decisions are driven by value perceptions [10,16,44,66], which is defined as what consumers gain for what they gave [66].

Our solution to online shelf management is to combine product price and popularity cues carefully to produce desirable value perception. Our solution is theoretically based on the cue consistency theory [2,49]. We propose that a proper combination of product price cues and product popularity cues can be used to influence consumers' value perception of products on the first page. Price cues refer to the strategy of placing some items on the first page so that the average price of the first page is higher than the average price of the following page. Product popularity cues (or popularity cues for short) refer to the strategy of placing “best-seller” or “hot-item” icons for some products on the first page. A proper combination of cues means that the presence of popularity cues on the first page is matched with a proper level of difference in average price between the first and the second page such that consumers believe the higher average price on the first page is justified because items on the first page in general offer a higher product value than those on the second page. We call the general value perception of all products on a page the page value perception. When the page value perception of the first page is boosted, consumers are more likely to buy items from the first page. In summary, our intuition is that consistent cues of the first page boost page value perception of the first page, which in turn affects the transaction distribution over pages in a web-based catalog.

This study makes a few important contributions to the literature. First, we extend the cue consistency theory from the individual product level to the product group level (i.e., the page level). Second, we introduce the notion of page value perception and confirm that it captures the spillover effect of consistent cues at the product group level. Third, we propose a practical way to identify a balance point at which the consistency effect between price and popularity cue can be achieved.

This paper is organized as follows: first, we introduce price signaling research and the cue consistency theory that underpins the proposed catalog design strategy. Hypotheses based on these theories are presented. Then, we report on a laboratory experiment that compared consumers' page value perceptions under different designs. Finally, we discuss the implications.

2. Theoretical background and hypotheses development

2.1. Price signaling and cue consistency theory

Consumers could consider product price as a monetary expense and/or as a quality cue [57,63]. In this study, perceived product quality is defined as a buyer's estimate of a product's cumulative excellence [66]. While the role of product price as a monetary expense is straightforward, its role as a quality cue is much less clear. The major findings in this stream of research are summarized as follows.

If price takes the role of a quality cue, there should be a positive correlation between price and product quality. Evidence has been accumulated that there is such a relationship, but the relationship is product-specific and generally weak [57,63].

For those products that price could potentially serve as a quality cue, the basic rationale is that price has a signaling effect [45,63]. The logic of price signaling is as follows. If a vendor of higher product quality wants to differentiate itself from one of lower product quality, it should set its product price high enough that although the product may lose some sales because of a higher price, it is still profitable. However, the price is not profitable for the lower quality vendor to imitate because false signaling will forfeit future revenue when discovered. Price signaling can be used by a vendor not only to differentiate itself from other vendors, but also to differentiate products in its own product line [4].

Based on signaling theory, Kirmani and Rao [45] summarized several conditions for price to be a quality signal for product market: (1) there are market segments based on price sensitivity—certain consumers are more price sensitive than others; (2) pre-purchase information of product quality is scarce; (3) post-purchase information about quality is ambiguous so that consumers can observe the existence of correlation between price and objective quality; (4) the misuse of price as a quality signal is vulnerable to consumer sanction, such as the refusal of future transactions; and (5) consumers are aware of the payoff of a product such that they can gauge which price level can be interpreted as a signal. Condition one and two can be regarded as the necessary conditions for price to be a potential quality signal in a product market. Condition three to five indicate that the price signal should be verifiable to ensure its truthfulness.

After consumers go through the whole online shopping process, the criteria for signaling are likely to be met. While some consumers shop online for convenience, others are price-sensitive and search for a better price. Moreover, online shopping could be risky and demands trust in the vendor [15,37,43,47,56,65,67]. Therefore, the first two basic conditions for price signaling are met. Upon product delivery, it is often possible to inspect the product. Consumers would also compare the product with other products bought offline or online to gauge its value. If the product is unsatisfactory, consumers could write reviews about a vendor to warn other consumers. Therefore, the signal verifiability criteria (i.e., criteria 3–5) are likely to be met.

However, the criteria for price signaling are not always met, especially before consumers go through the whole shopping process. In such circumstances, the credibility of price as a quality cue is hard to verify. Consequently, the price–quality relationship has been found to be weak or absent in some contexts.
The interest of price signaling research later shifted to the search for conditions of the price–quality relationship. A few moderators have attracted the most attention, including product brand, store name, and product rating. A well-studied cue is brand. However, the interaction of brand with price is inconclusive. Although an early meta-study by Monroe and Krishnan [52] suggested that the presence of brand information enhances price as a quality cue because the two cues can enhance each other when they are consistent. Dodds et al. [21] systematically tested the moderating effect of brand and found that the effect of price on quality perception is higher when it is the single cue than when it is combined with a brand name or a store name. Brucks et al. [9] even had contradictory findings in one study: while the presence of brand information enhances price sensitivity and price search, the relative importance of price to quality is not moderated by the presence of brand information. Another study by Dodds [20] again found no interaction between brand and price nor between store name and price.

Miyazaki et al. [51] suggested cue consistency theory [2,49] as a theoretical lens to investigate the price–quality relationship and to explain such inconsistencies. Cue consistency has been used to examine other research topics such as consumers’ perceptions of product quality [51], online word-of-mouth [24,42], and web assurance seals [35]. According to cue consistency theory, multiple information sources are more useful when they provide corroborating information than when they offer disparate conclusions. For example, Miyazaki et al. [51] find that when high price is paired with another positive cue (e.g., a strong warranty or a strong brand name), a synergistic interaction exists between them, in which the effect of either cue is strengthened by the presence of the other. However, when cues are inconsistent, negative cues attract more attention [1,12,30,35] because they are regarded as more salient and more diagnostic than positive cues [30].

Priming effects are considered as the underling mechanism to such effects. One cue serves as a prime. If it is ambiguous and subject to different interpretations (e.g., multiple categories of interpretation are activated), the other serves to disambiguate the categories activated by the first cue by choosing one as final [29,30]. For example, a high price might activate a product image of either high expense or high quality. The brand name may help to disambiguate which interpretation is more plausible. Miyazaki et al. [51] attributed the failure to observe the interaction effect in earlier studies to insufficient experimental manipulations—the product price was not high enough to match the other cues such as brand, warranty, or country origin. Their study confirmed that price in fact serves as a quality cue if the manipulation is strong enough to match the other cue.

In summary, the price signaling and cue consistency research suggest that price could suggest cost or quality. However, before consumers go through the whole shopping process to be able to verify the credibility of price as a quality cue, other quality cues may help to triangulate the price cue. The effectiveness of other quality cues depends on the consistency between them and price cues.

### 2.2. Cue consistency in online catalog design

In the light of price signaling and cue consistency theory, we then investigate the possible designs of price cues and other cues for online product catalog design. As suggested before, in the two-page catalog context, an intuitive design is that the first web page has a higher average price than that of the second page. The two pages can be regarded as rivals against each other for sales. The higher price of the first page is intended to be a signal of higher quality such that consumers would view products on the first page as of higher value, i.e., the first page has a higher page value perception.

While value perception is conventionally applied to individual products, we apply it to the page level. This generalization is justified for the following reasons. First, the well-known “gestalt principle” [46] in human perception states that people have a tendency to perceive an “organized whole” if the elements are close to each other (i.e., the proximity principle), similar in attributes (i.e., the similarity principle), and continuous in spatial distribution (i.e., the continuation principle). Products in one web page follow these principles and therefore induce a group perception. This perception of products on a page as a whole can be regarded as a category perception [61]. Notice the notion of category perception in this instance refers to the groupness of a set of objects [61], rather than the perception of a product category (e.g., PDAs vs. notebooks). Second, when a category perception is formed for products in one web page, even when it is a weak category perception [6], consumers either form an average price perception for the category or take a typical product in the category as an exemplar. This prototypical or exemplar price is then used as a reference price for comparison with other pages to form a high or low perception [53]. Therefore, there is a generalization process from items to the page. This generalization process can occur to price perceptions as well as to product quality and product value perceptions. Based on the gestalt principle, we define the page value perception and the impact of price cues on it. The extant literature has empirically confirmed that the impact of an individual item on the utility perception of a product assortment goes beyond its additive effect [13,41].

However, in the light price signaling theory, the intuitive design is unlikely to bring a higher page value perception to the first page, which is observed because before consumers receive and inspect the physical product, the price of products on the first page cannot serve as a clear quality signal when there is no other information to triangulate the actual product quality. In short, the conditions to establish the credibility of price as a quality signal [45] are not met. As a result, higher prices suggest more cost to consumers. Consequently, the higher prices of the first page alone lower individual product value perceptions and overall page value perception.

The above reasoning is based on the assumption that consumers can detect price differences between two consecutive web pages. However, if the price difference is subtle and below the noticeable level, consumers might not be aware of it. Past research on price elasticity found that (1) there is a latitude of acceptance around a reference price, and the price change within this latitude leads to little or no sales change [26,54]; (2) the thresholds of the latitude around a reference price are not symmetrical, and consumers are more sensitive to price increase than to price decrease [26,54]; and (3) the effective price threshold that leads to sales change differs across brands, product categories and market segments [25,26,54]. For example, Kalwani and Yim [40] suggested that the threshold is approximately 6%. Gupta and Copper [25] found it to be 10–20% for different brands. Pauwels et al. [54] suggested that consumers can be sensitive to price change less than 5%. While the just-noticeable price difference for a particular product category shall be determined empirically, we can hypothesize the effect of price difference levels on page value perceptions.

**H1.** When price is the only cue in an online product catalog of two web pages:

**H1a.** if the average price of products on the first web page is higher than that of the second web page at a noticeable level, the page value perception of the first page is lower than that of the second page, and
H1b. If the average price difference is below the noticeable level, the page value perception of the two consecutive web pages would not be different.

Cue consistency theory provides a foundation for the design of price distribution in a multi-page online catalog. If price alone does not serve as a quality cue, will the presence of another cue change the situation? In particular, we ask two questions: (1) What should be the other cue? (2) What should be the appropriate price level that is consistent with the cue?

As an alternative to the intuitive design, we consider product popularity cues as a good candidate to complement price cues. Product popularity is defined as the number of sales accrued to a product. This popularity can be iconized as a “best-seller” or “hot-item” and applied to the product display. Although it is also possible to use brand for this purpose, brand is not always applicable when all products in a category are not branded (e.g., flowers) or of the same brand. Cues, such as product ratings by experts or other consumers, may not be available all of the time. Popularity cues are not only easily available to vendors based on past sales data but also have good theoretical properties for potentially working with price cues.

Popularity cues can be regarded as a type of word-of-mouth. Word-of-mouth represents one of the most influential sources of information with well-documented benefits [14,24,42]. An early study by Herr et al. [30] has observed that word-of-mouth helps disambiguate consumer’s interpretation of other product attributes. First, word-of-mouth is found to affect consumer purchase decisions [29,36,58] because it reduces consumers’ perception of risk and increases their trust [36,37]. The presence of popularity cues on the first web page eases consumers’ worry that the vendor is pushing for larger sales upfront and increases their trust by suggesting these items are placed upfront because other consumers valued them. Second, in an information–scarce environment, other consumers’ choice can lead to a “herding behavior” [5,8]. The followers simply follow the predecessors’ decision and believe the predecessors have picked the high value products. If the products are regarded as of a higher value, the followers’ sensitivity to the higher price is reduced and they are less likely to search further for a cheaper substitute. Finally, the popularity of some products might make the followers believe the vendor has established a consumer base, and certain predecessors have checked out the value of products and still come back. The abovementioned reasons collectively suggest that (1) popularity cues signal product value directly and (2) because those products are believed to offer a higher value, compared to other cheaper substitutes, their prices are justified by their value and their product quality is believed to be adequate. In other words, the presence of popularity cues can potentially make prices be interpreted as a quality cue.

Based on the gestalt principle, popularity cues affect not only value perceptions at the individual product level but also spill over to the whole page. For example, Kalyanam et al. [41] observed that the removal of a key item in a product category hurts the category sales far beyond the loss of sales of the removed item itself.

While popularity cues have the potential to interact with price, the appropriate price level to be consistent with the popularity cue is a concern. In Miyazaki et al.’s [51] study, to sufficiently manipulate the price difference, the higher price was set to be about five times the lower price. Even in Dodds et al.’s [21] study, where the price manipulation was not considered to be sufficiently strong, the higher price was 5% more than the lower price. Uhl and Brown [62] noticed that 84% of consumers can notice a 15% deviation in price. The above manipulations were far above the just-noticeable difference and were at an ostensible level.

While such ostensible price manipulation is possible in a two-product comparison context, it is impractical in an online product catalog because products in two pages of a category usually target similar consumer needs. Putting all expensive products in one page and inexpensive ones in another creates a very different image of them and defeats the original purpose to serve the same consumer segment. Conversely, if the price manipulation is too subtle to detect, there will be no ground for the cue consistency effect. A possible choice is to set the price at the “just-noticeable” level [40].

While determining the best level for price difference is an empirical issue, the above analysis implies that the interaction between popularity cues and price cues is not linear, but nonlinear. When the price cue is too weak, consumers will not use it as a cue because they are not even aware of the difference. When the price cue is too obvious, consumers will consider it as too high to be justified. Only when the price cue is appropriate will consumers perceive it to be the “fair premium” for good quality. Moreover, even if an ostensibly high price is still considered as a quality signal, the marginal utility of higher quality might not be enough to offset the perceived sacrifice in expense. Without a strong theoretical explanation, Dodds et al. [21] also proposed that there could be an inverted U-shape relationship between price and product value perception, although they failed to find it. In the presence of a popularity cue, we hypothesize a nonlinear interaction effect between popularity cues and price levels:

H2. When popularity cues are present on the first page of an online catalog of two consecutive web pages, there is a nonlinear interaction effect between the use of price cues and popularity cues on page value perceptions such that

H2a. If the average price of products in the first web page is higher than that of the second page but barely noticeable to consumers, the page value perception of the first page is not different from that of the second page.

H2b. If the average price of products in the first web page is higher than that of the second page and at about the just-noticeable level, the page value perception of the first page is higher than that of the second page, and

H2c. If the average price of products in the first web page is higher than that of the second page and far above the just-noticeable level, the page value perception of the first page is not higher than that of the second page.

Because consumers’ purchase behavior is affected by their value perception [10,66], their page value perception is likely to affect the page where they make a purchase. As mentioned before, the rationale is that the page value perception embodies the spillover effect and stems from the value perception of individual products but spills over to other products. As a result, the probability of a product being chosen is not only a function of its own properties, such as its price and presence of popularity cue but also the page value perception of its page. Therefore, we hypothesize the following:

H3. The probability of a consumer purchasing from the first page is positively affected by the page value perception.

3. Research method

3.1. Experimental design

A lab experiment was conducted to test our hypotheses.

3.1.1. Subject and incentives

A total of 161 students were recruited from a major university. Participation was voluntary. Subjects were paid $5 for participation.
Ages ranged from 17 to 25, and the average age was 21. Thirty-nine percent of the subjects were female, and 61% were male. The subjects had 6.5 years of Internet experience on average. Forty-eight percent of the subjects had online purchase experience and the average number of online purchases was 7. The experiment was held in a computer laboratory with approximately 20 subjects in each session. The subjects were instructed not to disclose the experiment details to others.

3.1.2. The experimental product and website

The experimental task was to purchase flowers from an online florist. We chose flowers for the following reasons. First, flowers are not a search product but an experience product. Additionally, before receiving the flowers, it is difficult to judge their quality in terms of freshness and attractiveness of arrangement, which is in line with the signaling theory that requires objective product quality to be difficult to gauge before use for price to be a quality signal [45]. Flowers do not have other external cues such as brand or warranty as confounding factors. Choice is abundant; typical online florists arrange products in multiple web pages, offering consumers many options.

Our experimental website was a simulated online gift store. Products were classified into categories (e.g., flowers, gifts). Products in each category were distributed over two web pages. This experiment focused only on the online flower category, which had two web pages with 12 flower arrangements each. Flowers were displayed in a matrix format, the most popular format adopted by online florists (Fig. 1).

3.1.3. Manipulations

We have three independent variables: page accessibility, presence of product popularity, and price level of the first page. Page accessibility was operationalized as page number in the two-page setup. Product popularity was manipulated by the presence or absence of a “best-seller” icon for five randomly chosen products on the first page. To make these icons salient, they were animated. There was no popularity cue on the second page for all treatments.

The average price level for the first page was manipulated at four different levels: equal price across two pages (0% higher), the first page being 5% higher than the second page, the first page being 7% higher, and the first page being 10% higher. While prior literature has suggested ways to detect just-noticeable difference after a large dataset is collected [25], we chose thresholds based on a small scale pretest by asking 20 subjects to judge the difference of average page price for 4 designs. Zero percent was the benchmark; the other three were 5%, 10% or 15% higher in price. Because most subjects failed to detect 5% different but were able to detect 10% difference, we chose 5% to represent the undetectable price difference. We used 7% as the just-noticeable difference. We considered 10% to be ostensibly different.

However, rather than fixing the average price for the second page and adjusting that of the first page, the mean of the first page was fixed at $92 with a range of $60–112. Fixing the first page price range allowed us to compare page value perceptions of the first page in different designs. We adjusted the prices downward for the second page to create desired differences. Moreover, the range and variance of price in each page were carefully controlled to avoid range and distribution effect [53]. Although products were randomly allocated to the two pages in the very beginning, to counterbalance the different products for page 1 and 2, we further swapped products in the two pages for half of the subjects. Because the counterbalancing itself did not affect the result of our analysis, we will not discuss it further. Therefore, without considering the

![Fig. 1. Experimental website.](image-url)
counterbalancing manipulation, the experiment was a simple 2 (page number) \times 2 (popularity cues) \times 4 (price levels) design with page number being a within-subject factor and popularity cue and price level being between-subject factors.

The dependent variable was the page value perception. Adapting from previous research [21], we measured the page value perception with two items: (1) “I think in general, considering the prices, products on page 1 (or 2) offer (1—very poor value for money, 11—very good value for money)” and (2) “I think the products on page 1 (or 2) are good buys (1—strongly disagree, 11—strongly agree).” The reliability of the two items as measured with Cronbach’s alpha was 0.75. Actual choices made by subjects were recorded by the server.

3.1.4. Experiment procedure

Upon arrival, subjects were first asked to complete a pre-experiment survey for demographic information. The subjects were then randomly assigned to one of the designs, and each design had roughly the same number of participants. We asked the subjects to simulate an online flower shopping process for a loved one, as they would do in a real situation. Then, the subjects browsed the online store. No time limit was imposed, and the subjects took 15–30 min to complete the shopping task. To foster personal involvement, the subjects were asked to write down the occasion the flower was for before browsing and explain their choice after deciding on a product. After that, we gave them a distraction task (word puzzle) to further remove the recency effect of the last visited page and chosen product. Finally, the subjects answered the items for page value perception and some manipulation check items.

3.2. Data analysis

3.2.1. Manipulation check

All subjects browsed both pages as recorded by the server. To check the use of popularity cues, we asked subjects whether they observed the “best-seller” icons on the first page for some products. Ninety-one percent of subjects who did have such icons recognized them correctly. Post-experiment discussion with a few subjects who failed to report the presence of icons indicated that they misunderstood the question. Therefore, we did not drop them and considered the manipulation successful.

The conventional method for checking for price manipulation is to ask subjects whether they consider the price to be high or low using a Likert scale [21,51]. However, the manipulation of this experiment was not on an individual product but on the difference in price between pages. Therefore, we asked subjects whether the average price of the first page was higher, equal to, or lower than that of the second page.

In the equal-price treatment, 29% of the subjects considered the first page price to be higher. In the 5% treatment, 32% of the subjects considered the first page price to be higher. In the 7% treatment, 53% of the subjects considered the first page price to be higher, and the percentage was 54 for the 10% treatment. A chi-square test of the percentage difference confirmed that the 7% and 10% treatments were significantly different from the equal-price (i.e., 0% difference) and the 5% treatments (p < 0.001). However, the 0% treatment was insignificantly different from the 5% treatment (p = 0.16); the difference between the 7% and the 10% treatment (p = 0.80) was also insignificant. The insufficiency between the 0% and the 5% treatments confirmed that 5% was not noticeable to a significant number of subjects, which was expected. The insignificant difference between 7% and 10% suggested a weak manipulation in general. However, this could be due to the presence of the popularity cue, which could distort the price perception for certain treatment groups (i.e., the price was not considered high when there were popularity cues). We further compared the two groups under the condition of no popularity cue and found the difference to be marginally significant (p = 0.1). Therefore, overall, we still considered the manipulation successful. We did not discard subjects who did not perceive the difference because mentally calculating and comparing the average price in pages was a demanding task. The use of a distraction task further made the recall difficult. Therefore, such comparison should be regarded as a comparison of latent constructs rather than direct perceptions, and a latent construct is often not used for subject filtering.

3.2.2. Hypothesis testing

Hypothesis 1 basically states that without popularity cues, there is a difference in page value perception across two pages when the price level is noticeable (N = 76). Price differences at 0% and 5% were coded as not noticeable, while price differences at 7% and 10% were coded as noticeable. This test employed a repeated measure design with one within-subject factor (i.e., the page) and one between-subject factor (i.e., noticeability).

The result (Fig. 2) indicated that when the price difference was noticeable, the mean page value perception of the first page was significantly lower than that of the second page (ValueP1 = 6.09, SD = 0.19, ValueP2 = 6.75, SD = 0.25, p = 0.01). In contrast, when the price difference was not noticeable, the page value perception of the first page was not significantly different from that of the second page (ValueP1 = 6.70, SD = 0.24, ValueP2 = 6.57, SD = 0.28, p = 0.68). Overall, the result indicated that the interaction effect of page number and price level on page value perception was significant (F(1, 76) = 3.95, p = 0.05, \( \eta^2 = 0.05 \)). Therefore, H1 was supported. However, the main effect of page number on page value perception was not significant (F(1, 76) = 1.77, p = 0.19, \( \eta^2 = 0.02 \)), suggesting that the difference in page value perception was due not to the page accessibility but to the contrast in price.

Hypothesis 2 states that with the presence of popularity cues, there will be a nonlinear interaction effect between price difference and popularity cues. As an exploratory test before testing Hypothesis 2, we tested the main effect of popularity cues on the page value perception of the first page for all price levels (N = 161). One-way ANOVA was employed for this test. The mean page value perception of the treatment groups with popularity cues was 7.15 (SD = 0.16), and that of the groups without popularity cues was 6.28 (SD = 0.16). Planned contrast indicated that the difference was significant (F(1, 159) = 11.66, p < 0.001). Therefore, the use of popularities cues had a significant main effect.

To test Hypothesis 2, we first compared the page value perception of the first page and the second page at different price levels for subjects under the condition of popularity cues (N = 83). This comparison was again a repeated measure design with page
number as a within-subject factor and price level as a between-subject factor. The result indicated that page number had a significant main effect on page value perception ($F(1, 79) = 5$, $p = 0.03, r^2 = 0.06$), with the first page being higher than the second page ($ValueP1 = 7.14, SD = 0.16$, $ValueP2 = 6.61, SD = 1.6, p = 0.03$). The higher page value perception of the first page could be due to multiple reasons: the presence of popularity cues, as well as the cue consistency effect in some of the designs. Although this result is expected, it does not point to a single mechanism that would lead to a higher page value perception.

We are more interested in the non-linear interaction effect between price and popularity cues on page value perception. We conducted a trend analysis for the page value perception of the first page at different price levels ($N = 83$). The result indicated that the linear relationship was insignificant ($t = -0.53, p = 0.60$), as was the quadratic relationship ($t = -1.29, p = 0.20$), but a cubic relationship was supported ($t = -2.67, p = 0.01$), which lends support to Hypothesis 2. Pair-wise comparisons of page value perceptions between two pages at each individual price level indicated that at the 0% level, the difference was insignificant ($ValueP1 = 7.24, SD = 0.32$, $ValueP2 = 6.62, SD = 0.35, p = 0.23$), at the 5% level, the difference was insignificant ($ValueP1 = 6.84, SD = 0.34$, $ValueP2 = 6.61, SD = 0.23, p = 0.58$), at the 7% level, the difference was significant ($ValueP1 = 7.85, SD = 0.31$, $ValueP2 = 6.70, SD = 0.35, p = 0.04$), and at the 10% level, the difference was again insignificant ($ValueP1 = 6.64, SD = 0.26$, $ValueP2 = 6.5, SD = 0.35, p = 0.76$). Therefore, Hypotheses H2a, H2b, and H2c were supported. Fig. 3 summarizes all the page value perceptions at different levels for both pages.

To test Hypothesis 3, we conducted a logistic regression (Table 1). The dependent variable was whether a purchase was from the first page. Both page value perceptions were the main independent variables. To control for product specific influences on purchase decision, we also included the price of the chosen product and whether it had a popularity cue. To control for subject specific factors, we included subjects' age, gender, years using the Internet, online purchase experiences, and online gift-shopping times. Because both the dependent variable and page value perceptions were subject to the influence of the same manipulations, manipulations could serve as confounders of the correlation between page value perceptions and the purchase. Therefore, we included the price and popularity cue treatment condition in the analysis. With all of these factors, the result indicated that, except for page value perceptions, all control variables were insignificant, including the manipulation variables.

The page value perception of the first page had a significant positive effect on the probability of a purchase thereof ($b = 0.34, p = 0.03$), while the page value perception of the second page had a significant negative effect ($b = -0.47, p = 0.002$). Therefore, we conclude that Hypothesis 3 was supported. The insignificance of manipulation variables suggests that their effects were mediated by page value perceptions. The insignificance of individual product attributes (i.e., price, presence of popularity cue) indicates that the spillover effect of page value perception was above and beyond the effect of individual products.

4. Discussion and implications

Online product catalog design is an important aspect of website design and online retailing. Based on price signaling literature and cue consistency theory, we set out to search for a proper way to distribute prices over multiple web pages of a product catalog. Our experiments indicate that if vendors are to sell higher price items on the first page for increased revenue and, ideally, increased profit, price cues should not be used alone. Rather, price cues should be used with other cues. Product popularity cues are good candidates because they help establish the conditions for price to be a quality signal and to boost the overall page value perception, as this study found.

### Table 1

<table>
<thead>
<tr>
<th>Variables</th>
<th>B</th>
<th>SE</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Page value P1</td>
<td>0.34</td>
<td>0.15</td>
<td>0.03</td>
</tr>
<tr>
<td>Page value P2</td>
<td>-0.47</td>
<td>0.15</td>
<td>0.00</td>
</tr>
<tr>
<td>Price</td>
<td>0.01</td>
<td>0.01</td>
<td>0.72</td>
</tr>
<tr>
<td>Product with popularity cue</td>
<td>21.48</td>
<td>6692</td>
<td>0.99</td>
</tr>
<tr>
<td>Age</td>
<td>-0.11</td>
<td>0.16</td>
<td>0.49</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.43</td>
<td>0.43</td>
<td>0.32</td>
</tr>
<tr>
<td>Internet experience (years)</td>
<td>-0.04</td>
<td>0.10</td>
<td>0.68</td>
</tr>
<tr>
<td>Online purchases</td>
<td>-0.11</td>
<td>0.50</td>
<td>0.82</td>
</tr>
<tr>
<td>Online gift purchases</td>
<td>0.01</td>
<td>0.06</td>
<td>0.51</td>
</tr>
<tr>
<td>Popularity cue (treatment)</td>
<td>-0.05</td>
<td>0.41</td>
<td>0.91</td>
</tr>
<tr>
<td>Price level (treatment)</td>
<td>0.04</td>
<td>0.06</td>
<td>0.47</td>
</tr>
<tr>
<td>Constant</td>
<td>3.32</td>
<td>3.66</td>
<td>0.36</td>
</tr>
</tbody>
</table>

![Fig. 3. Consumer page value perceptions.](image-url)
Furthermore, not all ad hoc combinations of price cue and product popularity cue will help boost sales. Instead, prices of products on the first page must be set at the right level to achieve the best synergy with other cues to produce the quality signaling effect. We suggest that the justnoticeable level (e.g., 6–8%) can be considered as a good starting point for exploration. When a cue consistency effect is achieved, a better page value perception is formed for products on the first page and better sales can be generated from the first page. Our experiment supported this conclusion.

However, the results of this study must be interpreted in the context of its limitations. First, we tested the cue consistency strategy for only one product category, that of flowers, the applicability of which to other product categories is subject to further verification. This strategy, similar to other price signaling strategies in general, hinges on the assumption that consumers do not have enough information of product quality attributes. For standard search products, such as electronics or even computers and major appliances, product quality attributes are typically partially available online; the cue consistency strategy may not be as effective in these contexts. However, the cue consistency strategy may still work for consumers who are unable to interpret product attributes [57]. Second, this study did not examine other cues that could potentially work with price cues, such as product brand and warranties. Future research can investigate those areas. For example, would other consumers’ comments on the product enhance the effectiveness of popularity cues and price cues? Finally, although the just-noticeable price difference was generally successful in our experiments, the appropriate level of price manipulation might vary for different product types, different average price levels, and different price dispersions. While we suggest the just-noticeable level to be a good starting point, a trial-and-error process is recommended to locate the best combination of cues. With all these limitations in mind, the study provides a number of significant theoretical and practical implications.

4.1. Theoretical implications

First, this research fills the gap in past literature, which largely overlooked the issue of product distribution over pages. Previous research on online product catalog design has studied the effect of product layout format [32,33], the spatial distribution of products in one page [38], the effect of sorting or filtering [11,48,50], order effect [18], image and text size [55], and the impact of the accessibility of product attribute information [3,27,28]. This study suggests that the design of an online product catalog is not only about the use of text, graphics, navigation and layout. Format design should be combined with marketing cues to achieve better business performance because online product catalogs and online “shelf space” are not equally accessible. Consumers make transactions only from the first few web pages. The first few pages of an online catalog should be considered to be the online storefront. Just as offline vendors do their best to maximize the attractiveness of their storefronts [22], so should Internet vendors. A better design strategy is to fully apply marketing cues to the storefront design and carefully arrange the products on the “shelves” such that consumers perceive a higher value for products on the front shelf. Because consumer decision making is constrained by the information environment [11,27], this study presents a good example of how to design an information environment for better business performance with consumers’ page value perception as a mediator.

Second, this study introduces the notion of page value perception. The main theoretical importance of page value perception is that it captures the spillover effect of cue design. While cues are ultimately applied to individual products, their effect is not only limited to those products. Other products in the same page also benefit because the perception of cues at the page level (e.g., the presence of popularity cues) establishes an environment where the other cues of individual products (e.g., the price of a product) can be interpreted. Therefore, this study extends the notion of cue consistency to a product group level (i.e., the page level in this study). Our empirical test shows that the effect of page value perception is significant even after controlling for product level attributes. This result not only confirms the conventional wisdom that value perception leads to purchase, it also confirms that page value perception is above and beyond the simple sum of individual product value perception. It is this added value that differentiates cue consistency at the product group level from that observed at the individual product level.

Finally, this study extends the current cue consistency literature by showing another way to achieve cue consistency. We show that if other cues could provide reasons to meet the conditions needed for price to be a quality signal, price signaling can be achieved. This extends the current cue consistency theory [51] in price signaling, which considered only the magnitude of price difference as a mechanism for cue consistency. What we suggest is that the magnitude of price difference is not the essence of consistency; in fact, employing appropriate level is. As our experiment demonstrates, if price is ostensibly adjusted upward, it must remain be inconsistent with other cues, and deteriorate as a quality signal. Therefore, the strategy of cue combination should be driven by the semantic complementarities of cues, not merely their magnitude.

4.2. Practical implications

Our study directly bears on online retailing practice. First, this study shows not only the importance of online product catalog design but also its impact on online sales for Internet vendors. Thus, this study suggests the importance of designing and managing the first a few web pages of an online product catalog to increase sales for Internet vendors. Consumers are more likely to pay attention to the first few web pages. However, merely placing high price products in the first few web pages is not sufficient to increase sales, unless price cues are interpreted in a positive way as quality signals.

Second, regarding the presentation of price cue as a quality signal, this study prescribes an effective approach to combine it with popularity cues. For Internet vendors who are in similar industries (e.g., online gift stores) with many products in a category, cue consistency should be carefully designed. This study showcases a practical direction to search for synergy: the first web page of an online product catalog could be set at about the justnoticeable level compared to that of the second or following web pages. Although the search for an optimal price level can be a matter of trial-and-error for online vendors, managers should avoid ostensibly overpricing products on the first page or making the price difference too subtle.

Third, our catalog design strategy might also apply to offline vendors who have a large array of products to display. Past price signaling literature did not investigate environments in which consumers face a large set of products. Laboratory experiments always use only one or a few products and assume that the search for additional product information is costly. Our online setting is most likely closer to the offline reality than what has been explored in past laboratory experiments. Therefore, it is also interesting to investigate whether offline shelf display and store layout would demonstrate the same cue consistency effect.

Finally, the study also raises an interesting issue for policy-makers. Because a consumer’s page value perception could be shaped by online product catalog design as demonstrated in this
study, cunning Internet vendors could design an online product catalog for unjustified profit. Should it be considered as a deceptive scheme, and should restrictions be imposed on such practice? Before such a policy debate is settled, this study alerts online consumers to a new potential vulnerability they may face when shopping online.

5. Conclusions

In summary, this study examines the design of an online product catalog consisting of multiple web pages and the impact of different designs on consumers' page value perception and vendor's sales. The fundamental contribution of this study is to highlight the existence and the importance of the synergic combination of price and other external cues (e.g., popularity cues) in product distribution over multiple pages. When multiple cues are consistent, the page value perception is boosted, and better sales could be generated from that page. This research extends the current cue consistency theory to a multi-product and multi-page context. This research also introduces the page value perception as an important notion to link cue consistency at individual product level to page level sales. Finally, this research offers practitioners an effective online product catalog design method that costs almost nothing.

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References

[38] K. Kalyanam, S. Borle, P. Boatwright, Modeling Key Item Effects, 2005 http://www.sscu.edu/business/faculty/research/2005-06-papers/upload/wp06-08-key-item-key-items.