Subadditive Bundle Preferences and the Value of Variety

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Product bundles may consist of multiple units of a single product (“uniform” bundles) or multiple units of more than one product (“mixed” bundles). In this paper, we examine consumer evaluations of mixed and uniform bundles. Two factors can explain preferences for mixed bundles. First, consumers may perceive each additional unit of a particular product as possessing less marginal value. Second, consumers may derive value from the variety offered by mixed bundles. In study 1, we demonstrate that although consumers do show diminishing marginal utility for uniform bundles of products, they combine products to form mixed bundles in a subadditive fashion. The observed subadditivity of mixed bundles is in turn consistent with two explanations. Consumers could discount bundles according to the total number of units they contain. Alternatively, consumers could show diminishing marginal utility for product attributes and judge bundles according to the (discounted) value of the attribute inventories in the bundle. In study 2, we show that bundle subadditivity does not vary with brand similarity. Results across both studies are consistent with the theory that consumers have diminishing marginal utility for individual products and for the total number of units in a bundle.
Consumers are often confronted with the option of buying goods individually or buying goods together in a bundle. Bundled goods occur across many different industries and product categories. Examples of bundled goods include software suites (e.g., Microsoft Office), bedroom furniture sets, season football tickets, and cases of fruit juice or lunch snacks. Despite the ubiquity of product bundles in the marketplace, little research has explicitly investigated how consumers value bundles of different composition.

Why do multi-product bundles exist? The majority of the work examining this question has focused on the benefits that bundles provide to the seller. It is well known, for instance, that bundles of multiple units of a single product allow sellers to achieve second-degree price discrimination, thereby allowing sellers to capture a greater proportion of the consumer surplus (Phillips 1983). Other work has explored the conditions under which selling only bundles of different products (a pure-bundling strategy) or both the bundles and the individual products (a mixed-bundling strategy) will maximize the seller’s profit (Adams and Yellen 1976). However, for multi-product bundling to be sustainable, these bundles must also offer value to consumers.

What value do consumers derive from bundles? First, consider consumers’ response to quantity. Most classical economic models propose that products provide diminishing marginal utility with increases in quantity. The second unit of a product is worth less than the first, the third is worth less than the second, and so forth. This implies that as the number of units of a given product increases, there will always occur a point at which the value of an additional unit of that product is less than the value of a unit of some other product. Thus, classical models predict that preference for mixed bundles is a
consequence of diminishing marginal utility for additional units of the individual products in the bundle.

However, other research has proposed that variety is attractive in its own right. Mixed bundles may generally be more attractive because they allow consumers to forestall the often-difficult consumption sequence decision. To the extent that two products trade off their characteristics, mixed bundles may allow consumers to achieve an otherwise unobtainable compromise, albeit over time. By allowing variety in consumption, mixed bundles may allow consumers to avoid satiating on a particular product, thereby increasing the overall hedonic value of the consumption sequence.

In this paper, we explore consumers’ preferences among bundles varying in quantity and product composition. In particular, we examine properties that are related to variety seeking among bundles. We find that subjects’ variety seeking is related to their tendency to discount bundles having multiple units of a uniform product. However, consumers’ variety seeking is also mitigated by a tendency to discount bundles at the aggregate level, indicating diminishing marginal utility for each unit in a mixed bundle.

**EVALUATING PRODUCT BUNDLES**

Product bundles can consist of multiple units of a single product or single units of multiple products. An evaluation of product bundles requires that consumers integrate the utility associated with individual units of each product into a judgment of the overall value of the bundle. A number of assumptions have been made regarding how utilities might be integrated. These assumptions, based either on behavioral hypotheses or on analytical tractability, constitute theories of product and bundle evaluation. We discuss these assumptions according to the literatures in which they were originally proposed. In
particular, we will discuss the assumptions common in economics and utility theory, those made in the behavioral literature on bundling, and the literature on variety seeking in marketing and psychology.

Classical economic theory predicts that the evaluation of products depends on the particular products in the bundle. When a bundle consists of multiple units of the same product, economic theory predicts that the perceived value of the bundle will increase less for each additional unit of the product. In other words, the marginal utility of a product is expected to decrease with quantity (Samulson 1976). This result is a side effect of the manner in which expected utility theory accounts for risk aversion (Bernoulli 1738/1954). However, it can also explain why quantity discounting is so common among retailers and manufacturers (cf. Dolan 1987; Nason and Della Bitta 1983; Rao 1980).

When each product in a bundle is unique, on the other hand, most economic theories assume that the utility of the bundle is equal to the sum of the utilities of each product considered individually (Adams and Yellen 1976; McAfee, McMillian, and Whinston 1989; Schmalensee 1984). Although exceptions have been made in the case of substitute and complimentary products, most work assumes that the utilities of unique products combine additively. Thus, unlike the assumptions made for uniform bundles, classical economic theory predicts constant sensitivity to quantity for mixed bundles.

Together, these assumptions can be used to predict when consumers will prefer mixed bundles to uniform bundles. Suppose that uniform bundles consist of a consumer’s most preferred product and that mixed bundles consist of a consumer’s first, second, and third most preferred products. According to the assumptions outlined thus far, this consumer will prefer a uniform bundle as long as the marginal utility of her preferred product is greater than her utility for the alternative product in the same ordinal position.
In particular, the utility of the second unit of the best product must be greater than the utility of the second best product, the utility of the third unit of the best product must be greater than the utility of the third best product, and so forth. This implies that consumers can prefer mixed bundles over uniform bundles having the same total number of units, but that it will depend on the degree to which she satiates on her most preferred product and on the relative value she places on alternative products available in bundles with the preferred product. In sum, economic theory predicts decreasing marginal utility for uniform bundles and additivity for mixed bundles. It permits consumers to prefer mixed bundles over uniform bundles of the same size, and explains such preferences through consumers’ perceptions of the products involved.

A second related literature is the behavioral bundling literature. A small number of researchers have examined consumers’ reactions to product bundles. Gaeth and colleagues (1990) presented subjects with bundles containing either related (VCR and videotapes) or unrelated (typewriter and calculator) products. The first product in each set was designated as a focal product and the second as a tie-in product. They manipulated the quality of each product in the bundle, and had subjects rate the quality and usefulness of each the products, both separately and bundled. They found that bundle ratings reflected an average of the values associated with the individual products. In other words, consumers in their study showed no preference for mixed bundles.

Similarly, Yadav (1994) presented subjects with related products ranging in perceived importance to the overall set. For example, one set contained a computer (most important), printer (less important), and printer stand (still less important). Yadav manipulated the description of the focal product and had subjects evaluate the individual products, the bundle of most and second-most important products, and the bundle of all
three products. He found that adding tie-in products to the focal product tended to increase bundle evaluations when the focal product was described as low quality, but decrease bundle evaluations when the focal product was described as high quality. Like Gaeth et al (1990), Yadav proposed that consumers evaluate bundles by averaging their perceived values for the constituent products. Furthermore, he proposed that this average weighted the focal product more heavily than the tie-in product, consistent with an anchoring and adjustment process.

Although the behavioral bundling results are provocative, they do not provide a general theory of bundle evaluation. The studies examine bundles including a small number of products, and more importantly, they do not vary the quantity of the products. Nonetheless, if we generalize the results of this literature, we would predict that consumers’ evaluations of multi-product bundles would reflect a (possibly weighted) average of the utilities of each constituent product. This implies that consumers will always prefer a uniform bundle of a preferred product to a mixed bundle involving that product and another, because adding less-preferred products to the bundle will only serve to decrease the average value of the bundle.

A final relevant literature includes work in marketing and psychology on reactions to variety. Much research in psychology and consumer behavior has addressed the antecedents and consequences of variety seeking. This research has typically considered situations in which consumers confront a particular choice set over time. For example, McAlister (1982) developed an attribute satiation model that considered how stores of underlying attributes changed over time in response to consumption activities. Kahn and Raju (1991) demonstrate that price promotions have differential effects for subjects who display high variety seeking (choosing different brands on different
occasions) versus high reinforcement behavior (choosing the same brand on different occasions) in IRI cracker data and laboratory choices of furniture polish. Likewise, Ratner, Kahn, and Kahneman (1999) examined subjects’ repeated choice of songs over the course of an experimental session.

Few studies have considered how variety seeking affects the evaluation of product bundles. However, a few notable exceptions exist: First, Simonson (1990) examined whether subjects choosing multiple items at one point in time for several different consumption occasions would choose differently than subjects asked to choose just prior to each consumption occasion. He found that subjects selected a greater number of variants when they chose simultaneously than when they chose sequentially. Simonson concluded that people often overestimated the degree to which their preferences would change over time, and hence selected more varied choices when choosing simultaneously. Similarly, Simonson and Winer (1992) show that when consumers make a greater number of simultaneous choices, the number of different product variants (e.g., different flavors of yogurt) increase, whereas the number of unique brands decrease.

Although most of the variety seeking literature has examined varied preference over time, a few papers have noted that a preference for variety may lead consumers to select bundles that contain a variety of products. In particular, Simonson’s work (Simonson 1990; Simonson and Winer 1992) suggests that consumers may derive additional utility when products are purchased together than when those products are purchased separately. In other words, consumers may perceive mixed bundles as offering greater utility than their constituent products because they allow for varied consumption experiences. This implies that, contrary to economic theory, mixed bundles will combine in a superadditive fashion. Like the economic literature, behavioral research on variety
seeking also predicts that consumers may prefer mixed bundles to uniform bundles. However, in this case a preference for mixed bundles is thought to derive from additional utility inherent in multi-product combinations, rather than from the perceptions of value of the individual products.

In summary, the above literatures all bear on a general theory of consumer evaluation of product bundles. However, each of these literatures employs different behavioral assumptions and produces different predictions. The economic literature predicts diminishing marginal utility for uniform bundles, and additivity for mixed bundles. Furthermore, it explains preferences for mixed bundles through consumers’ perceptions of individual products. The behavioral bundling literature predicts constant marginal utility for mixed and, by implication, uniform bundles. It predicts that uniform bundles will always be preferred to mixed bundles. Finally, the literature on variety seeking predicts superadditive evaluations of mixed bundles. It explains preferences for mixed bundles as due to how people evaluate bundles containing multiple unique products. In this paper, we aim to clarify these relationships and provide evidence that points toward a general theory of consumer response to bundles.

**Properties of Multi-Product Bundles**

In the following discussion, it will be helpful to consider different sorts of product offerings. Consider the set of product offerings shown in Figure 1. Rows show varying quantities of Milky Way bars and columns show varying quantities of Snickers bars. Cells in the first column designate uniform bundles of Milky Way bars. These offerings contain from one to four units of Milky Way bars. Similarly, the first row represents uniform bundles containing from one to four units of Snickers. The sixteen remaining cells represent mixed bundles in which one or more units of Milky Way are combined
with one or more units of Snickers. Let us refer to the utility of a uniform bundle having \(i\) units of Product A as \(U_{Ai}\). The utility of a uniform bundle having \(j\) units of Product B will be represented \(U_{Bi}\), and the utility of a mixed bundle having \(i\) units of Product A and \(j\) units of Product B will be represented \(U_{AiBj}\).

Our primary interest is to understand the processes underlying bundle evaluation. By varying the composition of a bundle, holding fixed the total number of units in the bundle, we can study variety seeking. Consider the cells in Figure 1 marked with an “A”. Two of these cells represent uniform bundles of four units, and the third represents a mixed bundle containing two Milky Way bars and two Snickers bars. If the mixed bundle is preferred to both uniform bundles, we classify this set of bundles as displaying variety seeking. More generally, an order shows variety seeking if \(U_{AiBj} > \max(U_{Ai+j}, U_{Bi+j})\). Likewise, orders that indicate \(U_{AiBj} < \min(U_{Ai+j}, U_{Bi+j})\) will be considered variety-averse, and orders that indicate \(\max(U_{Ai+j}, U_{Bi+j}) \geq U_{AiBj} \geq \min(U_{Ai+j}, U_{Bi+j})\) will be considered variety-neutral.

What other properties of multi-product bundles can we examine? First, consider the uniform bundles. They are composed of a uniform product and vary in number of units. A comparison of these bundles allows us to infer the consumer’s marginal utility for that product. In particular, if the value of these bundles increases at a decreasing rate, we infer that the consumer has diminishing marginal utility for that product, consistent with much work in economics and psychology (Samulson 1976; Stevens 1957; Herrnstein 1979). We can also assess consumers’ marginal utility for individual products among mixed bundles by comparing bundles that vary in the number of units of that product, holding constant the number of units of the other product. For example,
comparing the cells marked “B” enables us to assess the consumer’s marginal utility for Snickers for mixed bundles containing one Milky Way bar.

Next, consider how consumers’ might value mixed bundles relative to uniform bundles. In Figure 1, cells marked “C” represent two uniform bundles (containing two units of Milky Way and Snickers, respectively) that together produce the third (a mixed bundle of two Milky Way and two Snickers bars). One possibility is that the consumer will value the additional variety offered by the mixed bundle positively, as is implied by the variety seeking literature (Simonson 1990; Simonson and Winer 1992). If so, the consumer’s evaluation of the mixed bundle will be greater than the sum of her evaluations of the two constituent uniform bundles. This property, which we will refer to as superadditivity, implies that the value of the mixed bundle is greater than the combined value of its constituent uniform bundles ($U_{AiBj} > U_{Ai} + U_{Bj}$).

A second possibility is that consumers perceive no additional value in the mixed bundle beyond what has already been accounted for in the utilities of each constituent uniform bundle separately. If this is the case, we should find that the consumer’s evaluation of the mixed bundle is equal to the sum of her evaluations of the uniform bundles. This property of additivity ($U_{AiBj} = U_{Ai} + U_{Bj}$) is implicitly assumed in most classical economic theories (Adams and Yellen 1976; McAfee, McMillan, and Whinston 1989; Schmalensee 1984). It does not necessarily imply that consumers never prefer mixed bundles. As shown in Appendix A, consumers may prefer mixed bundles to uniform bundles of the same total size despite valuing mixed bundles in an additive fashion.

A third possibility is that consumers perceive less value in the mixed bundles than would be expected based on their evaluations of the uniform bundles, resulting in
subadditivity ($U_{AiBj} < U_{Ai} + U_{Bj}$). This could be because they (1) discount mixed bundles according to the total number of units included, or (2) value mixed bundles according to the amount of different attributes they contain (Lancaster 1966) and satiate on individual attributes (Inman 2001). We will discuss these hypotheses further prior to study 2.

In summary, if consumers find bundles of multiple brands valuable, we should see superadditivity in mixed bundles. If they see no value in variety beyond that already considered in the uniform bundles, we should see additivity. And if consumers evaluate bundles based on their attributes and satiate on those attributes, or if consumers discount mixed bundles based on the total number of units in the bundle, we should see subadditivity in mixed bundles.

**The Relationship Between Marginal Utility, Additivity, and Variety Seeking**

How might consumers’ marginal utility and (sub/super)additivity explain their attitude towards variety in bundles? First, suppose that the marginal utility for both products is constant. If consumers have superadditive valuations for mixed bundles, then their judgments will show variety seeking. (A proof of this and the propositions to follow is included in Appendix A.) If mixed bundles show additivity, then consumers will be variety neutral, and if they show subadditivity, consumers will be variety averse.

Alternatively, suppose that the marginal utility of both products decreases with quantity. If mixed bundles show superadditivity, then consumers will be variety seeking. However, it is not the case that if mixed bundles show subadditivity, consumers will be variety averse. Consumers may prefer mixed bundles despite having subadditive bundle preferences if marginal utility for the products is decreasing. This would occur if the effect of diminishing marginal utility for the products outweighs the effects of subadditivity.
Analogously, suppose that the marginal utility of the products increases. In this case, if mixed bundles show subadditivity, then consumers will be variety averse. However, if mixed bundles show superadditivity, it is not necessarily the case that consumers will be variety seeking. Consumers may prefer uniform bundles despite having superadditive preferences if marginal utility is increasing.

In summary, this analysis shows two independent mechanisms through which variety-seeking bundle preferences can occur. First, consumers may perceive increases in the quantity of different products to have decreasing marginal value. Second, consumers may perceive mixed bundles as offering greater value, and hence combine brands in a superadditive fashion.

In study 1, we examine the extent to which consumers prefer mixed bundles, and whether such behavior can be explained by diminishing marginal utility for the products, superadditive bundle combination, or both. Based on prior literature, we expect subjects to seek variety. Because we do not control subjects’ preferences for the products, we cannot predict the relative incidence of variety seeking and variety neutral responses. However, if subjects tend to prefer mixed bundles, we will find that the proportion of variety-seeking orders will be greater than the proportion of variety-averse orders.

**H1:** Subjects will show greater variety seeking than variety aversion.

Furthermore, if variety seeking is due to subjects’ general preference for multi-product bundles, we will find greater evidence of superadditivity than of subadditivity in their bundle evaluations. If variety seeking is due to satiation for the individual products, we will find greater evidence of decreasing than of increasing marginal utility.

**H2:** If variety seeking is due to satiation for the individual brands, we will find greater evidence of decreasing than of increasing marginal utility.
**H3:** If variety seeking is due to a preference for multi-brand bundles, we will find greater evidence of superadditivity than subadditivity.

Note that hypotheses 2 and 3 are not mutually exclusive – consumers may express both satiation for individual products and a preference for multi-product bundles. In fact, as shown in Appendix A, if data are consistent with both H2 and H3, variety-averse orders are not permitted.

**STUDY 1**

**Method**

This study presented subjects with uniform and mixed bundles of candy based on the design presented in Figure 1. Bundles contained either one or two candy products, Milky Way and 3 Musketeers bars. For each bundle, subjects stated a reservation price for the bundle.

**Stimuli and Design.** We created bundles of varying numbers of units of either one or two products. Single-product bundles included from one to four units of each product, for a total of eight uniform bundles. Mixed bundles were based on a $4 \times 4$ factorial design of the two products.

**Method.** Subjects first rated their familiarity with and preference for each brand of candy. (The familiarity scale ranged from $1=Not\ Very\ Familiar$ to $7=Very\ Familiar$. The preference question asked “How much do you like this snack?” and ranged from $1=Not\ At\ All$ to $7=Very\ Much.$) Following this, subjects saw each of the 24 bundles in random order and provided a reservation price for each. Subjects were told to express prices in dollars and cents, and that if they saw absolutely no value in the bundle, they should
assign it a reservation price of $0. Subjects wrote a brief paragraph after the pricing task describing how they made their responses.

Subjects. A total of 36 undergraduate students participated in exchange for course credit. One subject who assigned reservation prices of $0 to every bundle was excluded from the analysis.

Results

Aggregate Results. Not surprisingly, quantity affected reservation price in both uniform and mixed bundles. The effect of quantity was significant for both Milky Way and 3 Musketeers in uniform bundles ($F(3,136) = 9.79$ and $10.08$, respectively, both $ps < .001$). A 2 (product) × 4 (quantity) ANOVA showed a main effect of the quantity variable ($F(3,272) = 19.77$, $p < .001$) but neither the main effect of product ($F(1,272) < 1$, $ns$) nor the interaction between product and quantity ($F(3,272) < 1$, $ns$) were statistically significant. This is not to say that subjects did not have preferences between the brands of candy. Rather, their preferences were heterogeneous and non-systematic across subjects.

We then conducted a separate ANOVA on the mixed bundles. Again, the main effect of quantity was significant for both products ($F(3,544) = 17.3$ and $F(3,544) = 15.4$ for Milky Way and 3 Musketeers, respectively, both $ps < .001$) whereas the interaction was not significant ($F(9,544) < 1$, $ns$).

Attitude towards Variety. Next, we examined the degree to which subjects’ preferred mixed bundles over uniform bundles having the same total number of items. In our design, there are six mixed bundles that can be compared to uniform bundles of equal size, for a total of 240 tests. Assigning a higher reservation price to the mixed bundle than to either uniform bundle indicates variety seeking behavior. Assigning a price for the mixed bundle that lies between the prices of the two uniform bundles indicates variety-
neutrality, and assigning a higher price to both uniform bundles than to the mixed bundle indicates variety aversion. Situations in which the mixed bundle was assigned the same price as either or both uniform bundles were classified as variety-neutral.

We found that 54 (26%) of the 240 tests indicated variety seeking, 129 (54%) indicated variety neutrality, and the remaining 27 (18%) indicated variety aversion. The most frequent preference order was one in which the mixed bundle was preferred over one uniform bundle, but not the other. Note, however, that the large number of variety neutral orders is due in part to the decision to classify ties in reservation price as variety neutral. Of the 129 orders indicating variety neutrality, 92 were ones in which the mixed bundle was judged to have a reservation price equal to one or both uniform bundles. Upon removing ties, we find that there are slightly more comparisons indicating variety seeking (54) than indicating variety neutrality (37). The difference between variety seeking and variety neutral orders is marginally significant ($\chi^2 = 3.21, p < .06$) and the difference between variety seeking and variety averse orders is significant ($\chi^2 = 9.0, p < .005$), consistent with Hypothesis 1. The same phenomenon was observed at the subject level. The number of subjects who had more variety seeking orders than variety averse orders (18, 51%) was marginally significantly greater than the number of subjects who had more variety averse than variety seeking orders (9, 26%, $\chi^2 = 3.0, p < .10$).

In sum, we find substantial evidence of variety seeking among multi-product bundles. There are significantly more orders consistent with variety seeking than with variety aversion, consistent with Hypothesis 1. Furthermore, the difference between variety seeking and variety-neutral orders is marginal when non-diagnostic cases are
removed. This tendency towards variety seeking could be explained by the heightened value of multi-brand bundles or by satiation for individual products. We test these explanations in the following sections.

**Brand Satiation.** One explanation for the observed variety seeking is that subjects satiate on individual brands, and therefore discount the value of additional units of a brand. This explanation implies that the marginal utility of each brand decreases with quantity of that brand, holding fixed the quantity of the second brand. One way to test this property is to fit a power model to the data for each brand in each combination. If the estimated power parameter is significantly greater than one, the data show increasing marginal utility. If the estimate is significantly less than one, the data show decreasing marginal utility. If brand utility increases linearly with quantity, the estimated power parameter should be equal to one. We fitted the following three models to the reservation prices for uniform bundles of Milky Way, 3 Musketeers, and mixed bundles of the two, respectively.

\[
U_i = i^{MW} + \beta \\
U_j = j^{TM} + \beta \\
U_{ij} = i^{MW} + j^{TM} + \beta
\]

(1)  
(2)  
(3)

*MW* and *TM* represent the power parameters for Milky Way and 3 Musketeers, respectively, and *β* represents an additive constant. Models were fitted using the NLIN iterative nonlinear regression procedure in SAS.

All three models provided statistically significant accounts of the data (*F*(2,138) = 28.8, *F*(2,138) = 30.4, and *F*(3,557) = 49.7, respectively, all *ps < .0001). Table 1 lists the

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1 Because this test compares non-independent samples, we use McNemar’s (1947) test of correlated proportions. All tests reporting χ² statistics without an associated degree-of-freedom use this test and are distributed χ² with one degree of freedom.
estimates, standard errors, and approximate 95% confidence intervals for each parameter in each model. The power parameter estimates tended to be approximately .5, and were significantly less than one indicating decreasing marginal utility, consistent with the brand satiation hypothesis (H2).

We also fitted these models at the subject level. Model 1 accounted for a significant portion of the variability for 15 of the 35 subjects. Of these, 11 had estimated $MW$ parameters that were significantly less than 1, and the remaining four had parameter estimates that did not differ significantly from 1. Model 2 also accounted for a significant portion of the variability for 15 subjects, and in this case 12 had estimated $TM$ parameters that were significantly less than 1. The remaining three subjects had $TM$ estimates that did not differ significantly from 1. Model 3 accounted for a significant portion of the variability for 25 of the 35 subjects. Of these, 21 had estimated $MW$ and $TM$ parameters that were both significantly less than 1. The remaining four subjects had estimates that did not differ significantly from 1 for one or both power parameters. In short, there is substantial evidence of brand satiation both at the aggregate and at the individual subject level. Consistent with Hypothesis 2 and prior literature, we observe decreasing marginal utility for both products for the vast majority of subjects.

**Bundle Additivity.** A second potential explanation for the observed variety seeking behavior is that people tend to prefer bundles involving more than one product over bundles that contain a single product. One implication of this hypothesis is that brands will combine in a superadditive fashion. The value of a mixed bundle will be perceived as greater than the sum of the values of its component uniform bundles. If

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2 The remainder of the subjects either had little or no variability in their data or had data that could not be adequately explained by the model. This result is not surprising given that there were only four data points per subject for models 1 and 2.
consumers associate no additional value with mixed bundles, they should combine bundles additively. Finally, if consumers value attributes with decreasing marginal utility or discount bundles based on the total number of units included, we expect them to combine uniform bundles in a subadditive fashion.

Subjects priced 16 mixed bundles. Each of these bundles can be compared to the sum of the reservation prices of the component uniform bundles. If the reservation price for the mixed bundle is greater than the sum of the reservation prices for the uniform bundles (superadditivity), that comparison is consistent with the hypothesis that consumers associate greater utility with mixed bundles. If the mixed bundle price is equal to the sum of the uniform bundle prices (additivity), the comparison indicates that consumers derive no additional utility from combining uniform bundles. And if the mixed bundle price is less than the sum of the uniform bundle prices (subadditivity), the comparison is consistent with both the attribute-satiation and .

We found that 319 (57%) of the 560 total tests indicated subadditivity, another 127 (23%) indicated additivity, and the remaining 114 (20%) indicated superadditivity. The proportion of tests indicating subadditivity is significantly greater than the proportion indicating either additivity or superadditivity ($\chi^2 = 83$ and $\chi^2 = 97$, respectively, both $ps < .001$). The proportion of additive and super additive tests did not differ significantly ($\chi^2 = 0.7$, ns). These results were also observed at the individual level. Twenty-seven of the 35 subjects (77%) had more tests consistent with subadditivity than with superadditivity, two subjects were perfectly additive for every test, and five subjects (14%) had more tests consistent with superadditivity than with subadditivity.

We conclude that there is considerable evidence for the subadditivity of mixed bundles. The vast majority of subjects assigned reservation prices to the mixed bundle
that were less than the sum of the reservation prices they assigned to the component uniform bundles. This result implies that the variety seeking bundle preferences described earlier cannot be explained by a general preference for multi-product bundles. Instead, our results are consistent with the view that variety seeking among bundles occurs due to consumers’ decreasing marginal utility for brands, and in spite of generally subadditive bundle combination. We explore two explanations for subadditivity in study 2.

**Discussion**

The results of study 1 indicate that subjects frequently prefer mixed bundles to uniform bundles of the same total quantity. Furthermore, our results indicate that such variety seeking can be attributed to product satiation – the value of adding an additional unit of a product to the bundle decreases with the number of units of that product already contained in the bundle. Variety seeking cannot be explained by a preference for bundles containing multiple unique products. Instead, subjects’ evaluations of mixed bundles were generally subadditive.

The subadditivity observed in study 1 is especially interesting. Subadditivity runs counter to the notion that multi-product bundles are inherently more attractive because they offer consumers greater flexibility in their consumption schedule. It implies that consumers perceive greater value in the separate uniform bundles than they do when those bundles are combined to form a single mixed bundle.

Why are bundle preferences subadditive? Two different mechanisms can produce subadditivity. First, suppose that consumers evaluate bundles not based on the products they contain per se, but based on the attributes of those products (Lancaster 1966). If brands tend to trade off their appealing characteristics (as would be expected when dealing with a Pareto-optimal set of alternatives) and consumers satiate on the product
attributes, consumers will tend to both prefer mixed bundles and make subadditive bundle evaluations. Many researchers of variety seeking behavior have found evidence of attribute satiation in sequential consumer choices (McAlister 1982; Inman 2001). If similar processes drive bundle evaluations, consumers will ignore the boundaries between products and focus only on the attribute inventories offered in each bundle. By purchasing a mixed bundle, consumers can effectively produce a compromise between the attributes that each brand offers in high quantity. Such a compromise is not possible when one purchases bundles containing multiple units of a single brand. So, according to the attribute satiation hypothesis, the preference for mixed bundles is then driven by consumers’ satiation for the attributes.

Similarly, evaluation by attributes with diminishing sensitivity predicts subadditive mixed bundle evaluations. Consider Brands A and B, which vary on attributes X and Y. Suppose that Brand A has 5 units of X and 1 unit of Y, whereas B contains 1 unit of X and 5 units of Y. A uniform bundle of three As contains 15 units of X and 3 units of Y, while a uniform bundle of 3 Bs contains 3 units of X and 15 units of Y, and a mixed bundle of 3 As and 3 Bs contains 18 units of X and 18 units of Y. If consumers judge bundles by their attributes, the utility of the first and second uniform bundles are given by $U_{3A} = u_X(15) + u_Y(3)$ and $U_{3B} = u_X(3) + u_Y(15)$, respectively. The utility of the mixed bundle, on the other hand, is given by $U_{3A3B} = u_X(18) + u_Y(18)$. If consumers satiate on the attributes ($u_X$ and $u_Y$ show diminishing marginal sensitivity), it will always be the case that $U_{3A} + U_{3B} > U_{3A3B}$. In other words, the decreasing marginal utility of the attributes imply subadditive mixed bundle evaluations. Because evaluation by attributes predicts that consumers attend only to attribute information, products are
predicted to have their greatest value when consumed in disaggregated form. (This is also the reason that the account predicts decreasing marginal utility for uniform bundles.)

A second mechanism that can explain subadditivity is unit discounting. According to this account, consumers first discount bundles according to the number of units of each product (product satiation). They then discount the aggregate bundle according to the total number of units it contains. The first form of discounting, by itself, produces decreasing marginal utility for uniform bundles, or for mixed bundles that hold constant the number of units of one brand. However, if consumers only discounted brands within a bundle, their mixed bundle evaluations would be additive. By also discounting bundles according to the total number of units, bundle discounting can explain subadditive bundle evaluations.

How can we distinguish these two accounts of subadditivity? One approach is to systematically vary the similarity of the products contained in the bundles. Suppose we present consumers with bundles of products A, B, and C as in Figure 1. The products vary along two attributes such that A and B are more similar than A and C. For example, suppose that Product A is Milky Way, Product B is 3 Musketeers, and Product C is Skittles. A and B are both chocolate bars with nougat, and are rated high in chocolate content. Skittles are chewy fruit candies, and are therefore considered low in chocolate, but high in fruit flavor, a characteristic that A and B are lacking.

As shown in Appendix B, if consumers evaluate bundles based on attributes, and satiate on both attributes, subadditivity is predicted to increase monotonically with the similarity of the products. Thus, if consumers evaluate bundles by their attributes, we should find greater subadditivity between A and B than between A and C. In fact,
subadditivity is at its greatest when Product A and B do not differ. As expected, in this case the degree of subadditivity equals that of uniform bundles.

**H4:** If subadditivity is due to evaluation by attributes, subadditivity will increase with the similarity of the products in the bundle.

If subadditivity is due to unit discounting, on the other hand, similarity of the products should have no impact on the degree of subadditivity. According to this account, bundle preferences are driven entirely by the utility of the number of units of each product they contain. As long as the products are perceived as approximately equally desirable, this account predicts that the degree of subadditivity will not vary with the similarity of the brands involved.³

**H5:** If subadditivity is due to unit discounting, subadditivity will not change with the similarity of the products in the bundle.

In summary, we can distinguish the attribute satiation and unit-discounting accounts of bundle subadditivity by systematically varying the similarity of the products. Attribute satiation predicts that subadditivity will increase with product similarity, whereas unit-discounting predicts that subadditivity will remain constant (or decrease) with product similarity. We test these predictions in study 2.

**STUDY 2**

Study 2 explores the relationship between brand similarity and bundle subadditivity. Study 2 was identical to Study 1 except that the stimulus design was expanded. Bundles contained different numbers of three products that varied in overall pair-wise similarity. These were Milky Way, 3 Musketeers, and Skittles. The stimulus

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³ It should be noted that one could also consider product similarity in terms of aggregate utility. In this case, unit discounting predicts a relationship between subadditivity and similarity that depends on the ordering of
design used in study 1 was replicated for each of the three product pairs, deleting
duplicate uniform bundles. The resulting design consisted of 12 uniform bundles (4
quantities of each of three products) and 48 mixed bundles (16 bundles for each of three
product pairs). A total of 71 subjects participated in this study. One subject who would
not purchase any of the bundles, and thus assigned reservation prices of $0 to every
bundle, was excluded from analysis.

Results

Attitude towards variety. Results of the pricing task were similar to those seen in
study 1. Subjects again showed a tendency to seek variety among bundles. We found that
222 (18%) of the 1260 tests indicated a preference for the mixed bundle over either of the
uniform bundles of the same size. 950 (75%) of the orders indicated variety neutrality,
and the remaining 88 tests (7%) indicated variety aversion. With ties removed, there were
139 orders (11%) classified as variety neutral. The number of variety seeking tests was
significantly greater than the number of variety averse tests ($\chi^2 = 58, p < .01$). The results
at the individual level were similar: 38 subjects had more tests indicating variety seeking
than variety seeking, while 14 showed the reverse pattern ($\chi^2 = 11, p < .01$).

Subadditivity. As in study 1, results in study 2 showed significant subadditivity.
1271 (38%) of the 3360 tests indicated subadditivity, 1401 (42%) indicated additivity,
and 688 (20%) indicated superadditivity. Table 2 presents the number of tests consistent
with subadditivity, additivity and superadditivity for each brand pair. We found the
greatest number of subadditive orders among bundles of Milky Ways and Skittles (444).
The number of subadditive orders was virtually identical for bundles of Milky Ways and

the products. For the products used in study 2, this version of unit discounting predicts that subadditivity
will decrease with product similarity. Details and proof available from the first author.
3 Musketeers (413) and bundles of 3 Musketeers and Skittles (414). None of these proportions differed significantly from any other ($\chi^2 = 1.12, \text{ns}$, for the comparison of 413 and 444). Furthermore, there was no significant variation in the tests across bundle sets ($\chi^2(4) = 4.71, p > .25$). In short, we saw no evidence of a relationship between subadditivity and brand similarity. This result is consistent with the unit-discounting hypothesis (H5), but is contrary to the attribute satiation hypothesis (H4).

**GENERAL DISCUSSION**

This paper unites three important streams of marketing literature: economic theories of utility, psychological and marketing research on variety seeking, and research on bundling. Although these literatures deal with related subjects, they have remained largely separate. The economic literature assumes that the marginal value of an additional unit of a product decreases with the number of units of the product offered, but assumes that unique products combine additively. Although this literature has examined the strategic implications of quantity discounting, it has not considered consumers’ response when different products are bundled together. The behavioral bundling literature, on the other hand, has examined the process by which consumers evaluate bundles of different products, but has tended to use bundles containing a single unit of each product (Yadav 1995; Gaeth, et al. 1990). Finally, the literature on variety seeking shows that consumers will often alter their purchase and consumption behavior over time in order to achieve greater variety. However, the variety seeking literature has tended to focus on variety over time, and has seldom examined simultaneous purchases of different products (see Simonson 1990; Simonson and Winer 1992; and Harlam and Lodish 1995 for notable
exceptions). We integrate these literatures by asking how consumers form preferences for bundles containing multiple units of multiple products.

We find that consumers’ interest in mixed bundles is strong. In both studies, subjects’ preference orders show substantially more variety seeking than variety aversion. These preferences for mixed bundles could result either from a preference for multi-product bundles or from product satiation. Study 1 shows that subjects’ bundle evaluations show decreasing marginal utility, consistent with product satiation. However, study 1 also shows subadditivity, which is inconsistent with a preference for mixed bundles.

The subadditivity shown in study 1 can be explained by two mechanisms. According to one, consumers evaluate bundles based on the attributes that compose the products, rather than the products themselves. Such a mechanism is consistent with Lancaster’s (1966) theory of consumer choice. Alternatively, subadditivity could be produced through consumers’ discounting of the overall bundles according to the total number of units they contain.

These hypotheses can be distinguished by varying the similarity of the products. The attribute satiation hypothesis predicts that subadditivity will increase with the similarity of the products, whereas the unit-discounting hypothesis predicts that subadditivity will not vary with product similarity. In study 2, we show that subadditivity does not vary with similarity, counter to attribute satiation. Our results in both studies are consistent with the theory that consumers evaluate bundles by first discounting based on product satiation, followed by a second discount based on the total number of products in the bundle. This double-discounting theory predicts decreasing marginal utility and subadditive bundle evaluations. It also predicts a preference for mixed bundles when the
degree of product satiation is sufficient to overcome the subadditivity produced by unit discounting.

**Theoretical Implications.** This research suggests conclusions to some theoretical issues in consumer behavior, while at the same time raising other issues. First, it suggests that the results of the literature on behavioral bundling (Yadav 1994; Gaeth et al. 1990), which indicate that consumers judge small bundles of unique products by averaging product utilities, do not generalize to multi-product bundles in general. We find a significant number of preference orders that favor a mixed bundle over uniform bundles of the same total size. This result is inconsistent with a process that simply averages the utilities of the products in the bundle. Our results imply that although some bundles are consistent with an averaging rule, such a rule does not adequately explain the consumer’s general response to bundles.

This research also provides evidence regarding satiation processes and how they impact consumer preference. Recently, Inman (2001) published a detailed review of psychological research on sensory-specific satiety. This research indicates that the pleasantness of a food decreases immediately after it is eaten, while the pleasantness of other foods remains the same or increases. Furthermore, the observed satiation appears tied to the sensory characteristics of the food (e.g., flavor, texture) and not to its nutritive value. This research implies that consumers should satiate on sensory characteristics of food and perhaps other categories to a greater degree than they will satiate on brand. In two consumer panel studies, Inman finds that the rate of flavor switching is considerably greater than the rate of brand switching, consistent with this thesis.

In study 2 of this paper, we compare two explanations of mixed bundle subadditivity: attribute satiation and unit discounting. We find that the degree of
subadditivity does not vary with the similarity of the products in a mixed bundle, counter
to the attribute satiation hypothesis. This result does not necessarily imply that attribute
satiation does not affect bundle preferences. Rather, the result merely implies that
attribute satiation cannot explain the observed subadditivity.

What is the status of attribute satiation in bundles? One possibility is that attribute
satiation does not impact bundle preferences. If attribute satiation derives from processes
of sensory-specific satiety, as Inman (2001) suggests, consumption may be a prerequisite
for attribute satiation to occur. Consumers purchasing a bundle of products at a single
time, or purchasing products at different times without intervening consumption may not
invoke sensory-specific satiation processes, leading to lesser desire for variety. It should
be noted, however, that the results of Simonson (1990) and Simonson and Winer (1992)
argue against this conclusion.

A second possibility is that attribute satiation processes do occur in bundle
evaluation, and that consumers’ utilities for uniform bundles already account for this
satiation. According to this account, the diminishing marginal utility observed among
uniform bundles and among mixed bundles holding fixed the units of one product is a
direct result of attribute satiation. However, attribute satiation by itself implies that
subadditivity will be sensitive to product similarity. Thus, if attribute satiation is to
explain decreasing marginal utility but not mixed bundle subadditivity, we must postulate
a two-stage process in which consumers first aggregate the attribute inventories that
would result from all units of each product separately into an overall utility for that
product. Then consumers integrate the utilities across products in the bundle without
regard for the underlying attributes, discounting for the total number of units in the
bundle. Future research should explore these possibilities.
Our work also speaks to issues regarding product substitutability and complementarity. Economic theory holds that the consumption of some products may alter the utility associated with other products. If consumption of one product raises the utility associated with another product, those products are said to complimentary (e.g., coffee and sugar). If consumption of one product lowers the utility of a second product, those products are said to be substitutes (e.g., coffee and tea). (See Samulson 1974 for a review and deeper discussion of economic perspectives on complementarity.) Although the underlying motivation of these principals is based on processes occurring at the level of the individual consumer, the empirical support for them comes primarily from market-level data (Samulson 1974).

One can view our research as examining bundle evaluations at three levels of substitutability. First, uniform bundles involve units of products that are perfect substitutes for one another. We used products that were unlikely to vary in quality or characteristics from one unit to another. Thus, the decreasing marginal utility we observed among uniform bundles in both studies can be thought of as reflecting the maximum degree of discounting for a substitute. In effect, nonlinear marginal utilities are a measure of subadditivity of products in uniform bundles.

Mixed bundles of Milky Way and 3 Musketeers bars involve products that, while not identical, are quite similar. We would therefore expect them to serve as moderate substitutes for each other. We should observe less subadditivity among mixed bundles of Milky Way and 3 Musketeers than we see within uniform bundles of either product. Similarly, mixed bundles that combine Skittles with either of the other products are predicted to show the lowest amount of subadditivity as these products serve as relatively poor substitutes for one another.
In short, economic theories of bundle evaluation predict that bundle subadditivity increases with the substitutability of the products in the bundle, with the upper limit being the quantity discounting observed for uniform bundles. Our results show that the degree of subadditivity does not vary with product similarity, contrary to this thesis. It should be noted that all the products used in these studies were functional substitutes of one another (they are all snack foods). This was done to maintain product bundles of high external validity. Nonetheless, bundles of independent products (e.g., snack foods and cleaning products) and complementary products (e.g., snack foods and fitness magazines) could be used. These would provide a stronger manipulation of product substitutability, giving more power to our test.

Finally, the fact that subadditivity does not vary with product similarity is consistent with a process whereby mixed bundles are discounted as a whole on the basis of the number of units they contain. Why might unit discounting occur? Perhaps unit discounting reflects an over generalization of common consumer heuristics. It is well known that consumers expect quantity discounts for uniform bundles (Dolan 1987; Nason and Della Bitta 1983). Although this discounting is based on decreased utility through duplication, the discounting process itself may reflect the application of simple cognitive heuristics. It is possible, then, that unit discounting represents an over-extension of these heuristics to the bundle as a whole.

**Conclusion.** Our research examines consumers’ evaluations of uniform and mixed bundles. We find that consumers frequently seek variety in bundles (prefer mixed bundles over uniform bundles of the same size). These preferences result from consumers’ perceptions of value at the product level, and cannot be explained by a preference for multi-product bundles in general. Results are consistent with the theory
that consumers first evaluate unique products, discounting each for quantity, and then combine these measures across products, discounting the result for the total number of units in the bundle. It appears that as the forms of abundance multiply, so do the forms of satiety.
References


Appendix A

This appendix details the permitted relationships among consumers’ marginal utility for different brands, the additivity of bundles, and consumers’ attitudes towards variety in bundles. We will represent the utility of a mixed bundle containing \( i \) units of product A and \( j \) units of product B as \( U_{AiBj} \) and the utility of a uniform bundle containing \( i \) units of product A (B) as \( U_{Ai} (U_{Bi}) \). The properties examined are as follows:

**Marginal Utility:**

- **Increasing:** \( U_{Ai} > U_{A_i} + U_{Aj} \)

- **Constant:** \( U_{Ai} = U_{A_i} + U_{Aj} \)

- **Decreasing:** \( U_{Ai} < U_{A_i} + U_{Aj} \)

**Bundle Additivity:**

- **Superadditive:** \( U_{A,B_i} > U_{A_i} + U_{Bj} \)

- **Additive:** \( U_{A,B_i} = U_{A_i} + U_{Bj} \)

- **Subadditive:** \( U_{A,B_i} < U_{A_i} + U_{Bj} \)

**Attitude towards Variety:**

- **Variety-Seeking:** \( U_{A,B_i} > \max (U_{A_{i,j}}, U_{B_{i,j}}) \)

- **Variety-Neutral:** \( \max (U_{A_{i,j}}, U_{B_{i,j}}) > U_{A,B_i} > \min (U_{A_{i,j}}, U_{B_{i,j}}) \)

- **Variety-Averse:** \( U_{A,B_i} < \min (U_{A_{i,j}}, U_{B_{i,j}}) \)

We begin by assuming, without loss of generality, that the utility of zero units of a product equals zero. Furthermore, because brand identities are arbitrary, let us assume that \( U_{Ai} > U_{Bi} \) for all \( i \).
Case 1: Constant marginal utility

Suppose that consumers evaluate mixed bundles in a superadditive fashion:

\[ U_{A_{ij}} > U_{A_i} + U_{B_j} \]  \hspace{1cm} (A1)

Because \( U_{A_i} > U_{B_i} \)

\[ U_{A_{ij}} > U_{B_i} + U_{B_j} = U_{B_{ij}} \] \hspace{1cm} (A2)

which contradicts the property of variety avoidance. Similarly, suppose that consumers evaluate mixed bundles in a strictly additive fashion:

\[ U_{A_{ij}} = U_{A_i} + U_{B_j} \] \hspace{1cm} (A3)

Because \( U_{A_i} > U_{B_i} \) and \( U_{A_j} > U_{B_j} \)

\[ U_{A_j} + U_{A_j} > U_{A_{ij}, j} > U_{B_j} + U_{B_j} \] \hspace{1cm} (A4)

indicating variety neutrality. Finally, suppose that consumers evaluate mixed bundles in a subadditive fashion:

\[ U_{A_{ij}} < U_{A_i} + U_{B_j} \] \hspace{1cm} (A5)

Because \( U_{A_j} > U_{B_j} \)

\[ U_{A_{ij}} < U_{A_i} + U_{A_j} = U_{A_{ij}, i} \] \hspace{1cm} (A6)

which contradicts the property of variety seeking.

Case 2: Decreasing marginal utility

Suppose consumers evaluate bundles in a superadditive fashion, as in Equation A1. Under decreasing marginal utility, \( U_{A_{i+j}} < U_{A_i} + U_{A_j} \), so the relationship in Equation A2 still holds. However, because the sum of two uniform bundles of the same product is greater than the uniform bundle of the sum of the units, Equation A6 no longer holds for subadditive evaluations, and only the right-hand inequality holds in Equation A4. This
means that if consumers show decreasing marginal utility for the brands and bundles are superadditive or additive, consumers cannot show variety avoidance. If bundles are subadditive, consumers may seek variety, avoid variety, or be variety neutral.

**Case 3: Increasing marginal utility**

Results are the converse of the Case 2 results. Suppose consumers evaluate bundles in a subadditive fashion, as in Equation A5. Under increasing marginal utility, $U_{Ai+j} > U_{Ai} + U_{Aj}$, so the relationship in Equation A6 still holds. However, because the sum of two uniform bundles of the same product is less than the uniform bundle of the sum of the units, Equation A2 no longer holds for superadditive evaluations, and only the left-hand inequality holds in Equation A4. This means that if consumers show increasing marginal utility for the brands and bundles are subadditive or additive, consumers cannot show variety seeking. If bundles are superadditive, consumers may seek variety, avoid variety, or be variety neutral.

**Summary**

Table 3 shows the permitted relationships under each case. Cells marked with a Y indicate that the specified relationship is permitted and cells marked with an N indicate that the specified relationship is not permitted. A key result is that variety seeking behavior may be produced by decreasing marginal utility (with any combination rule), a superadditive combination rule (with any pattern of marginal utility), or both.
Appendix B

This appendix demonstrates that if consumers evaluate bundles according to their underlying attributes, the degree of subadditivity will increase monotonically with the similarity of the brands. Consider three mutually nondominated brands, A, B, and C, each described by two attributes X and Y. Suppose that A and B are more similar than are either A and C or B and C, as seen in Figure 1. (For example, suppose that A and B are chocolate candy bars and C is a chewy fruit candy. A and B are more similar than the remaining pairs, both in terms of chocolate content and fruit content.) \(X_A\) and \(Y_A\) represent the values of brand A on the X and Y dimensions, respectively. By the definition of dominance, \(X_B < X_C\) and \(Y_B > Y_C\).

Assume, consistent with the results of study 1, that consumers tend to show diminishing marginal utility for increases in the number of units of a product. We will use \(U_X\) to refer to the utility derived from the X attribute and \(U_X\) to refer to the utility derived from the Y attribute. Diminishing marginal utility for the attributes implies that

\[
U_X(\alpha \cdot X_B) - U_X(\alpha \cdot X_C) \geq U_X(\alpha \cdot X_A + \alpha \cdot X_B) - U_X(\alpha \cdot X_A + \alpha \cdot X_C)
\]

where \(\alpha\) is a positive integer representing the number of units of the brand. Rearranging terms results in

\[
U_X(\alpha \cdot X_B) - U_X(\alpha \cdot X_A + \alpha \cdot X_B) \geq U_X(\alpha \cdot X_C) + U_X(\alpha \cdot X_A + \alpha \cdot X_C)
\]

The same result is true for Brands A, B, and C on the Y dimension, implying

\[
\left[U_X(\alpha \cdot X_B) - U_X(\alpha \cdot X_A + \alpha \cdot X_B) + U_Y(\alpha \cdot Y_B) - U_Y(\alpha \cdot Y_A + \alpha \cdot Y_B)\right] \geq \left[U_X(\alpha \cdot X_C) - U_X(\alpha \cdot X_A + \alpha \cdot X_C) + U_Y(\alpha \cdot Y_C) - U_Y(\alpha \cdot Y_A + \alpha \cdot Y_C)\right]
\]
Adding $U_x(\alpha \cdot X_A)$ and $U_y(\alpha \cdot Y_A)$ to each side and rearranging results in

\[
(U_x(\alpha \cdot X_A) + U_y(\alpha \cdot Y_A)) + (U_x(\alpha \cdot X_B) + U_y(\alpha \cdot Y_B)) - (U_x(\alpha \cdot X_A + \alpha \cdot X_B) + U_y(\alpha \cdot Y_A + \alpha \cdot Y_B)) \geq 0
\]

\[
(U_x(\alpha \cdot X_A) + U_y(\alpha \cdot Y_A)) + (U_x(\alpha \cdot X_C) + U_y(\alpha \cdot Y_C)) - (U_x(\alpha \cdot X_A + \alpha \cdot X_C) + U_y(\alpha \cdot Y_A + \alpha \cdot Y_C))
\]

(B4)

The first bracketed term on each side of Equation B4 represents the utility of $\alpha$ units of Brand A. The second bracketed terms on the left and right hand side reflect the utility of $\alpha$ units of Brand B and Brand C, respectively. Finally, the third bracketed term on the left side represents the utility of a mixed bundle of $\alpha$ units of Brand A and $\alpha$ units of Brand B, whereas the third bracketed term on the right represents an analogous combination of Brands A and C. Thus, the left hand side of the equation reflects the subadditivity between Brands A and B (the summed utilities of uniform bundles of Brand A or B minus the utility of the mixed bundle of Brands A and B) whereas the right hand side of the equation reflects the subadditivity between Brands A and C. The subadditivity between A and B (the more similar pair) is predicted to always be greater than the subadditivity between A and C (the less similar pair). In short, if bundle evaluations are based on the underlying attributes, we expect subadditivity to vary with the similarity of the brands. In particular, subadditivity is predicted to increase with the similarity of the brands.
Table 1: Parameter Estimates for the Power Models in Study 1.

<table>
<thead>
<tr>
<th>Model</th>
<th>Parameter</th>
<th>Estimate</th>
<th>Std. Error</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
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<td>MW</td>
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<td>0.072</td>
<td>0.436</td>
<td>0.719</td>
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<td></td>
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<td>0.034</td>
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<td>TM</td>
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<td>0.078</td>
<td>0.382</td>
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<td>0.143</td>
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<tr>
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<td></td>
<td>$\beta$</td>
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<td>-0.840</td>
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Table 2: Additivity Tests in Study 2.

<table>
<thead>
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<th>Additive</th>
<th>Superadditive</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Milky Way / 3 Musketeers</td>
<td>413</td>
<td>460</td>
<td>247</td>
<td>1120</td>
</tr>
<tr>
<td>Milky Way / Skittles</td>
<td>444</td>
<td>466</td>
<td>210</td>
<td>1120</td>
</tr>
<tr>
<td>3 Musketeers / Skittles</td>
<td>414</td>
<td>475</td>
<td>231</td>
<td>1120</td>
</tr>
<tr>
<td>Total</td>
<td>1271</td>
<td>1401</td>
<td>688</td>
<td>3360</td>
</tr>
</tbody>
</table>

Table 3: Summary of Relationships Among Marginal Utility, Bundle Additivity, and Attitude Towards Variety\(^a\)

<table>
<thead>
<tr>
<th></th>
<th>Var. Seeking</th>
<th>Var. Neutral</th>
<th>Var. Averse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td></td>
<td></td>
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<tr>
<td>Superadditive</td>
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<td>N</td>
</tr>
<tr>
<td>Additive</td>
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<td>Y</td>
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<tr>
<td>Subadditive</td>
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<td>Y</td>
<td>Y</td>
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<td>Decreasing</td>
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</tr>
<tr>
<td>Subadditive</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

\(^a\)N indicates that the pattern is not permitted under that combination of properties, and Y indicates that the pattern is permitted.
Figure 1: Schematic Illustration of Product Bundles.
Figure 2: Schematic Illustration of Brands Used in Study 2.