Ratios in Proportion: What Should the Shape of the Package Be?

Consumers' reactions to rectangles have implications for package and product design. In two lab studies and an analysis of field data, the authors find that the ratio of the sides of a rectangular product or package can influence purchase intentions and preferences and is related to marketplace demand. In more exploratory inquiries, the authors also find that the impact of this ratio on consumers depends on the relative seriousness of the context in which the product is used. Furthermore, ratio can also affect product perceptions, and consumers appear to prefer a range of contiguous ratios for different contexts rather than a particular ratio.

One of the oldest controversies in aesthetics, extending back to the ancient Greeks, is whether people prefer certain ratios for the sides of rectangles. Investigations into this question began in the 1870s with Fechner’s work and continue to the present day. The results of this research have been mixed. The research has not produced definitive conclusions about whether people consistently prefer particular rectangular ratios (Benjafield 1985; Green 1995).

Rectangular preferences have important implications for marketers because so many products and packages are rectangles. Recent research in the trade press suggests that a package’s shape is a critical way for a brand to differentiate itself because package design can affect consumers’ purchase decisions (Sherwood 1999). This has led many firms to focus on product and package shape, and small changes in package shapes can have a large influence on sales and profits (Prince 1994). Many of the “new age” beverages of the 1990s (e.g., Snapple, Arizona Iced Tea, Perrier) paid close attention to bottle design and are credited with helping spark a packaging renaissance (Miller 1994). With so much attention being given to the shape of products and packages, brand managers and designers who are responsible for introducing new products or for creating new shapes and packages for existing products need guidance on how rectangular proportions can affect consumer purchase intentions, preferences, and demand.

Marketers have proposed conceptual models of factors that may affect consumer reaction to product form (Bloch 1995). Bloch’s (1995) model proposes antecedents, mediators, and moderators of the impact of aspects of package shape on consumer preferences, intentions, and choice. Although Bloch’s model is rich in insights into possible influences on consumers’ reactions to product form and how consumers process visual information, it is primarily a conceptual model. Research has also begun to examine how package shape affects the managerially important variables of volume perceptions and consumption (e.g., Wansink and Van Ittersum 2003).

The current article examines one particular aspect of product design: We take the concept that people have different preferences for different rectangular ratios, an area that has received considerable attention in psychology and aesthetics, and apply it empirically to the consumer realm to answer questions of interest to marketing managers and product designers who deal with rectangular products and packages. Our principal objective is to investigate whether the ratio of the sides of a rectangular product or package—in other words, rectangles of interest to marketers—can affect consumer purchase intentions and preferences and to examine how ratio is related to marketplace demand. An additional objective is to examine, on an exploratory basis, additional issues in this domain of interest to marketing managers, such as whether ratios affect product perceptions, whether the impact of ratio on purchase intentions and preferences and the ratio’s relationship to market share depend on the context in which the rectangular product is used, and whether consumers tend to prefer a contiguous range of rectangular ratios for products and packages rather than one particular ratio.

Prior Research on Preferences for Rectangles

Aestheticians have long been interested in whether people find rectangles with certain ratios to be more pleasing than other ratios and how a rectangle’s aesthetic qualities might be related to the mathematical properties of its ratio (Alberti [1485] 1988; Huntley 1970; Lawlor 1982). This line of inquiry has also examined how often particular ratios appear in nature, such as in the structure of plants and animals (Ghyka 1977; Lawlor 1982).
Much of this work has focused on the “golden ratio,” or the $\Phi$ (phi) rectangle, which has a ratio of approximately 1.618. The number $\Phi$ has numerous special mathematical properties that have been studied by mathematicians such as Pythagoras, Euclid, and Fibonacci (Herz-Fischler 1987; Livio 2002). Some of these properties translate into visual properties (see Ghyka 1977; Huntley 1970; Livio 2002). The $\Phi$ is the only rectangle for which the ratio of the longer side to the sum of the sides equals the ratio of the short side to the longer side. If a square is removed from a $\Phi$ rectangle, the remaining rectangle is still a $\Phi$ rectangle. Repeating this process several times yields an attractive spiral such as that found in nautilus shells.

Advocates of the golden ratio’s aesthetic appeal point to its alleged use in major works of art and architecture, such as the building blocks of the Great Pyramids, the Parthenon’s facade, and paintings by Georges Seurat (see Ghyka 1977; Huntley 1970), whereas others are cautious about such claims (Livio 2002). In Bloch’s (1995) theoretical review of the factors that affect “ideal product form,” he posits that the golden ratio may appeal to people because of overall “gestalt” qualities that supersede any one particular characteristic. Although Bloch acknowledges the differences just discussed, he cites the gestalt qualities in “enduringly popular architectural forms” (p. 22) and notes that “it could prove useful for managers involved with design decisions to be acquainted with Gestalt principles … [and that] firms may find it useful to include these considerations” (p. 22).

Scientific investigations of whether people actually prefer certain rectangles began with Fechner’s (1871, 1876; for a recent translation, see Fechner 1997) pioneering work, which found a preference for the $\Phi$ rectangle. Other early researchers replicated Fechner’s results (Lalo 1908; Thorndike 1917; for a review, see Green 1995). However, research supporting a preference for the $\Phi$ rectangle, including Fechner’s, has been critiqued on methodological grounds (for reviews, see Green 1995; Plug 1980). Preferences can be influenced by participant instructions (Hekker, Lieke, and Van Wieringen 1994), preference measures (McManus 1980; Ohta 1999), elicitation (Höge 1995, 1997), the range of ratios used and the location of a ratio in that range (Benjafield and McFarlane 1997; Godkewitsch 1974; Piehl 1976), whether rectangles have equal area (Benjafield 1976), use of average versus individual preferences (McManus and Weatherby 1997; Plug 1980), and whether the rectangle is part of a more complex pattern (Boselie 1984).

Our studies control for many of these methodological concerns. Furthermore, rather than clearly linking the studies’ purposes to rectangular ratios, we use an indirect approach that is less likely to create demand artifacts (Green 1995; Höge 1995, 1997; Plug 1980). Study 1 uses a between-subjects rather than a within-subjects design; to disguise the study’s purpose, Study 2 participants make additional purchase intention ratings and rankings for design alternatives that do not involve rectangles; and Study 3 uses actual marketplace sales.

Rectangles as Objects Used in a Particular Consumer Context

Most studies of rectangular preferences have examined rectangles as abstract shapes, devoid of any particular meaning or use. This limits their application to real-world stimuli (Konen 1997). A major limitation for marketing is that consumers are not concerned with buying abstract rectangles but rather with products and packages that have a rectangular shape. Marketing managers and product designers need to understand how consumers are influenced by the proportions of these rectangular products and packages and use this knowledge to guide their own decisions about packaging and product dimensions. Bloch’s (1995) conceptual model recognizes the importance of this issue and approaches the impact of product form in a consumer setting rather than treating form abstractly.

Thus, there is a need for empirical research that examines consumer reactions to rectangles as they are applied to products and packages, not just rectangles in the abstract sense. Because marketers’ concerns extend beyond preferences to include consumers’ purchase intentions and demand, constructs that have little meaning when applied to abstract rectangles, we examine these latter issues. Thus, we investigate consumer reactions to rectangular products and packages, not abstract rectangles without context. Previous work in marketing has examined the distribution of the ratios of rectangular print advertisements and how the placement of headlines, pictures, text, and brand logo within an advertisement affects preferences for the advertisement (DeHeer and Nobbe 2000). However, we do not know of previous work that has examined how the rectangular ratios themselves affect purchase intentions, product preferences, and market share for products.

The remainder of this article proceeds as follows: Study 1 tests the hypothesis that in a consumer setting, the ratio of a rectangle can affect consumers’ purchase intentions and preferences for a particular product. On an exploratory basis, this study also tests whether ratio also affects certain consumer product perceptions. Study 2 replicates the test of this hypothesis for a different product category. On an exploratory basis, it also examines whether these purchase intentions depend on whether the context in which a product is used is relatively serious or relatively frivolous and whether higher purchase intent exists for a contiguous range of ratios rather than a particular ratio. Study 3 tests whether consumer demand for frequently purchased goods sold in rectangular boxes is related to rectangular ratio and whether the context in which a product is used moderates this relationship.

Study 1: Impact of Rectangular Ratio on Purchase Intentions, Preferences, and Perceptions

The Impact of Rectangular Ratio on Purchase Intentions and Preferences

Although the evidence that people prefer particular rectangles has been mixed, consistent throughout this research is
the notion that preferences indeed differ across ratios; that is, participants in these studies do not favor all rectangles equally. Applied to the realm of consumer products, this suggests that rectangular ratio can affect consumer preferences and purchase intentions because both constructs are related to demand.

H1: The ratio of a rectangle’s sides affects consumers’ (a) purchase intentions and (b) preferences for rectangular products.

**Design and Procedure**

Our sample consists of 108 undergraduate students (56 females and 52 males) enrolled in an introductory marketing course; they completed the experiment for partial course credit. Participants were told that the experiment was a study of musical tastes among students at their university. They were asked to assume that they had been mailed invitations with descriptions of two concerts (Concert A and Concert B). The words in the description of Concert A, titled “Music of Indonesia: Songs Before Dawn,” were printed in a square box that was six inches on each side (a 1:1 ratio). We used this concert as a control to create a reference point that people would compare with their judgments of a target concert (Concert B) and to control for individual differences in scale response. The target description of Concert B, titled “Dream Songs: Sounds of the Malaysian Rainforest,” was printed in a horizontal (width > height, as opposed to a vertical rectangle [width < height]) rectangular box with the ratio of sides either 1.38 or 1.62 (the golden ratio). Both boxes had the same area and contained the same description of Concert B (see Figure 1). We decided to include the golden ratio because this rectangle has been the subject of so much inquiry.

**Purchase intentions for CDs.** To measure purchase intentions for a product closely related to the concert, we asked participants to rate their likelihood of buying a CD of the music for Concerts A and B on a seven-point scale (1 = “definitely not,” 7 = “definitely”).

**Relative preference for concerts.** To measure relative preference for attending Concert A versus Concert B, we asked participants to indicate which concert they would prefer to attend if the two concerts were held at the same time, on a six-point scale with intervals labeled “strongly,” “moderately,” and “slightly” prefer Concert A or B. Higher numbers reflect a preference for Concert B.

**Covariates and controls.** Because purchase intention for the CD of Concert B is one of the dependent variables of interest and because ownership of CDs is also a useful indicator of experience with music, participants answered questions about the number of CDs they owned for use as a potential covariate; the response categories were as follows: 10 or fewer = 1, 11–50 = 2, 51–100 = 3, 101–200 = 4, and more than 200 = 5. To measure tendency to attend concerts, which might also be a useful covariate in concert preferences, participants reported how many live music concerts they attended in an average year. Participants also reported their gender (female = 0, male = 1). To assess whether ratio affected a cognitive phenomenon—namely, depth of processing—after a filler task, we administered a surprise recall task that was followed by a five-item multiple-response “quiz” on the content of the information provided for Concert B.

**Results**

**Purchase intentions.** To examine whether the ratio of the target concert description affected purchase intentions for the CD of Concert B, we used an analysis of covariance (ANCOVA) with purchase intentions as the dependent variable. The independent variables were the two different ratios of the Concert B invitation and gender, both coded as a categorical variable, and the scale for the number of CDs owned. The adjusted mean purchase intention for the CD of Concert B when the description was in the 1.62 ratio (M = 3.05) was greater than that for the 1.38 ratio (M = 2.22; F(1, 103) = 6.22, p < .05). Gender and CD ownership were not significant (Fs < 1.0). Thus, the results support the impact of ratio on purchase intentions (H1a). In this example, the 1.62 ratio created higher purchase intentions for the CD of Concert B than did the 1.38 ratio.

We also examined whether the impact of ratio on purchase intentions depended on an interaction between ratio and gender by adding this interaction term to the ANCOVA. This interaction term was not significant (F < .01).

**Impact of rectangular ratio on consumer perceptions.** Research on rectangular preferences in aesthetics and psychology has not usually examined attribute perceptions, because this work has tended to focus on abstract rectangles, not on consumer products that can be broken down into attributes. Because product perceptions matter to marketers, we believe that it is worth investigating, on an exploratory basis, whether the proportions of a rectangle in the context of a product or package affect consumers’ perceptions of that product.

Although the aesthetic literature on rectangular preferences has not formally tested hypotheses that connect particular perceptions, this literature often discusses the importance of perception in the creation of these preferences. Commentators mention that preferred rectangles promote perceptions of harmony, proportion, balance, rationality, and mathematical beauty (Ghyka 1977; Huntley 1970; Lawlor 1982; Livio 2002; Svensson 1977 [who uses a line partitioning task]). These perceptions are also relevant to many, though by no means all, consumer products. To investigate the potential impact of ratio on these perceptions, we also included in Study 1 perceptual measures of the concerts that we believed were related to these aesthetic perceptions in the literature. We measured relative perceptions of Concert B and Concert A on scales that included the items “harmonious,” “stable,” “beautiful,” “exciting,” and “fast” (1 = “B much less than A,” 4 = “B about the same as A,” and 7 = “B much more than A”). We intended the last two to be reversed. We call this construct “harmony” to indicate its source in the literature on rectangular preferences, which often mentions harmony. However, we do not claim that these perceptions encompass all perceptions that may be relevant to rectangular products or packages or that harmony is always the dominant perception.
FIGURE 1
Stimuli for Study 1

Control Concert A: Ratio = 1:1

Music of Indonesia: Songs Before Dawn
“Compelling ... Fascinating musical smorgasbord from this cultural crossroads.”

In the Banyuwangi region, located in the eastern end of Java, a vibrant and earthy musical genre called gandrung is performed. This tradition begins sometime around 9 p.m. and ends just before dawn. An unmarried female singer performs a beautiful suite of songs backed by a small ensemble of musicians who play violins and drums. The male guests at this dance pay money for the privilege of dancing with this mesmerizing songstress. Reticent yet dynamic, this call-and-response singing is accompanied by compelling rhythms played on percussion instruments that express and control the performance of the singers and dancers. This performance is by one of the music's finest living singers, Gadrung Temu. A recent review in the *SF Chronicle* called this “An enjoyable example of thoroughly contemporary and unusual exotica.”

Target Concert B: Ratio = 1:1.38

Dream Songs: Sounds of the Malaysian Rainforest
“Rhythms that lure you irresistibly away to the land of dreams.”

The Temiar people of the central Malaysian rainforest are deeply spiritual. Inspired by their vibrant natural environment, they have developed a musical landscape that evolves from their dreamsongs. Dreamsongs form the basis for community-wide singing and trance-dancing ceremonies, which celebrate marriages in Temiar society. Sophisticated and delicate, this music contains cherished and exquisite compositions performed with an enchanting mix of xylophones, gongs, cymbals, fiddles, guitars, and breathtaking vocals. Instrumental and vocal music of the Temiar draws listeners into a realm of ornate tonal variations and textured rhythms. The performance features Kam Maitrasangi, a master of the Temiar dreamsong technique. A recent review in the *SF Chronicle* called this “A good introduction to this highly passionate and expressive artform.”

Target Concert B: Ratio = 1:1.62

Dream Songs: Sounds of the Malaysian Rainforest
“Rhythms that lure you irresistibly away to the land of dreams.”

The Temiar people of the central Malaysian rainforest are deeply spiritual. Inspired by their vibrant natural environment, they have developed a musical landscape that evolves from their dreamsongs. Dreamsongs form the basis for community-wide singing and trance-dancing ceremonies, which celebrate marriages in Temiar society. Sophisticated and delicate, this music contains cherished and exquisite compositions performed with an enchanting mix of xylophones, gongs, cymbals, fiddles, guitars, and breathtaking vocals. Instrumental and vocal music of the Temiar draws listeners into a realm of ornate tonal variations and textured rhythms. The performance features Kam Maitrasangi, a master of the Temiar dreamsong technique. A recent review in the *SF Chronicle* called this “A good introduction to this highly passionate and expressive artform.”
Results for perceptual ratings. The five perceptual ratings all loaded on a single principal component (largest eigenvalue = 2.58, second eigenvalue = .84); absolute loadings ranged from .66 to .83. As we expected, “exciting” and “fast” loaded in the opposite direction of the other three perceptual scales. After reversing these two items, we averaged the five items to create a harmony index (α = .75); higher values indicate perceptions of greater harmony for Concert B than for A.

Relationship between perceptions and ratio. To examine the impact of ratio on the perceptual measure, we performed an ANCOVA with the perceptual scale as the dependent variable. The independent variables were the two categorical variables (ratio and gender) and CD ownership. The adjusted means show that participants rated Concert B as higher on the perceptual measure when the concert description used the ratio 1.62 (M = 4.70) than when the concert description used the ratio 1.38 (M = 4.32; F(1, 100) = 3.89, p = .051). The coefficient for gender was not significant (F < 1), nor was CD ownership (F = 2.57, p = .11). Thus, we find initial support that rectangular ratio can influence product perceptions, at least for a set of perceptions that are related to those often mentioned in the literature on rectangular preferences. We also examined whether gender and ratio interacted to influence perceptions by adding this interaction to the ANCOVA. However, the interaction term was not significant (F = .01, p > .5).

Impact of ratio on relative preferences. We also examined the impact of ratio on relative preferences to attend Concert A versus Concert B; we included the potential role of perceptions as a mediator in this relationship. We conducted an ANCOVA on the relative preference of the concerts using the likelihood of attending the concert as the covariate and ratio and gender as the two categorical independent variables. We included attendance to control for individual differences in the propensity to attend live concerts. The analysis also included the perception measure. As we discussed previously, this step determines whether perceptions are a potential mediator of the impact of ratio on relative concert preferences.

Preference for Concert B versus Concert A was marginally greater when the description of the former was presented in the ratio of 1.62 (adjusted M = 4.15) than when it was presented in the ratio of 1.38 (adjusted M = 3.68; F(1, 99) = 2.88, p = .093). Thus, the direction of preference is the same as that for purchase intentions, in support of H1a, though the evidence is not as strong as it is for CD purchase intentions (H1a). Gender, concert attendance, and the perceptual measure did not have a significant relationship to preference, suggesting that perceptions did not mediate the relationship between ratio and preferences. The interaction between gender and ratio was not significant (F(1, 99) = .23, p = .63).

Impact of ratio on cognitions. There were no differences in the amount of recall of the concert information across conditions or in the number of questions that participants correctly answered in the surprise quiz task at the end of the procedure. Thus, we found no evidence for differential depth of processing in the two Concert B ratios.

Discussion

In summary, the results of Study 1 show that a difference in the ratio of the sides of a rectangular concert description can affect purchase intentions for the CD of music from the concert and, to a weaker extent, preferences. On an exploratory basis, we also found initial support that the ratio can affect product perceptions that are related to an index of perceptions discussed in the aesthetic literature on rectangles.

Study 2: Purchase Intentions for Invitation Cards

Study 2 has three purposes: First, we test H1 in additional domains. Second, we examine H1a, regarding purchase intentions, across a larger set of rectangular ratios than the two ratios used in Study 1. Third, on an exploratory basis, we examine whether the impact of rectangular ratios on purchase intentions depends on the relative seriousness versus frivolity of the consumer context in which the product is used. We also examine whether consumers have higher purchase intentions when rectangles are within a contiguous range of ratios or when this is only a single ratio.

Test of H1 Across a Broader Set of Products and Rectangles

Although the comparison of two ratios in Study 1 creates a good starting point, many studies of rectangular preferences have included a larger set of ratios. Because rectangular consumer products and packages are found in the marketplace in a large range of ratios, we believe that it is useful to test H1a with more rectangles from a larger ratio range. Study 2 examines nine ratios, ranging from the square to the 2:1 rectangle. Furthermore, in Study 2, consumers report purchase intentions for four different product variants of a rectangular product, along with their favorite and least favorite ratio. This method allows for within-person and across-person analysis of the impact of rectangular ratio, an approach recommended in prior research (Plug 1980).

Context Effects in Consumer Reactions to Rectangles

On an exploratory basis, Study 2 also examines whether consumer reactions to rectangular products and packages depend on the context in which the product is used.2 Previous work by Benjafield and McFarlane (1997), who use it to describe how preferences for the Φ rectangle are affected by its location within the range of all rectangles that participants view.

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1We examined whether perceptions mediated the relationship between ratio and purchase intentions for the Concert B CD. A condition for mediation is that the proposed mediating variable must have a significant relationship to the dependent variable when the initial independent variable is included in the analysis (Baron and Kenny 1986). However, including the perceptions in the previous ANCOVA did not yield a significant effect for perceptions (F(1, 99) = .13, p = .72).

2Our use of the term “context” differs from that in the work of Benjafield and McFarlane (1997), who use it to describe how preferences for the Φ rectangle are affected by its location within the range of all rectangles that participants view.
ous conceptual work on consumer reactions to product form (Bloch 1995) has proposed how context, such as situational factors and cultural and social context, may affect consumer reactions to product form. Thus, we propose a particular context that should be relevant for rectangular products and packages, namely, whether the product is used in a relatively more serious versus less serious context. We focus on this context effect for the following reasons: As we discussed previously, many aesthetic theories on preferences for particular rectangles, as well as other shapes, have emphasized that certain rectangles have properties such as harmony, proportion, balance, rationality, and mathematical beauty (Ghyka 1977; Huntley 1970; Lawlor 1982; Livio 2002). When applied to a consumer perspective, this rationale suggests that consumers should prefer these rectangles when the product is used in a context that makes the consumer more sensitive to and appreciative of these particular properties. When consumers are in a relatively serious context, they are more likely to appreciate these qualities than when they are in a relatively less serious, frivolous context. Whereas many consumer contexts are serious, such as going to an art museum, others are more frivolous and may even be intended to reduce harmony, balance, rationality, and so forth.

We propose that in these latter, less serious contexts, products and packages that use ratios with these mathematical and aesthetic properties will not create higher purchase intentions than products and packages that use different ratios. We still expect purchase intentions to depend on ratio in relatively frivolous contexts, but we expect that this relationship differs from that in relatively serious contexts. Because we do not hypothesize which ratios will create the highest purchase intentions in relatively less serious contexts, we consider this investigation exploratory in nature. To pursue this line of inquiry, we include both relatively more serious and relatively less serious contexts in the product variants in Study 2.

**Design and Procedure**

The product of interest in Study 2 was custom-printed invitations for different events. The instructions read as follows: “Imagine that you are selecting invitations at the printer’s shop. The printer tells you that you have to make three different decisions to design the invitations for each occasion.” A total of 122 undergraduate students who were enrolled in a marketing course completed the experiment for partial course credit.

We manipulated rectangular ratio by asking participants to provide purchase intentions for rectangular invitation blanks for each of four occasions. The nine blanks varied in ratio from 1:1 to 2:1 in steps of approximately .13, which included the 1.62 (Φ) rectangle. Although Study 2 was not intended to focus specifically on the Φ ratio, we avoided placing the Φ ratio in the middle of the range because this placement can affect preferences (Benjafield and McFarlane 1997).

We labeled the card blanks with the letters A–I in the bottom right-hand corner using four different random orders; these labels were written to give half of the participants horizontal invitations and half of the participants vertical invitations. Although eye-tracking studies of how people view quadrangles have shown that scanning patterns do not vary consistently with quadrangle type, including differences in horizontal versus vertical orientation (Ohta 1999), we believe it is advisable to balance this orientation. Card blanks were shuffled into random order before being placed in an envelope. Thus, there were 8 different types of envelopes used (4 order of letters × 2 orientations) × 4 (order of occasions). To increase task realism and disguise the study’s purpose, participants made two other design decisions. The decisions were to choose envelope color (white, blue, green, or red) and the invitation’s font (there were five different options).

**The invitation contexts.** To examine whether ratio interacts with context to influence purchase intent, each participant was asked to choose cards for four different contexts, two of which were relatively more serious and two of which were relatively less serious. In a pretest (n = 40), we evaluated relative seriousness using a seven-point scale, anchored by “not at all serious” and “very serious.” The occasions chosen to be relatively more serious, which were a three-year-old child’s birthday party (M = 1.92) and an outing with adult friends to a three-ring circus (M = 1.68); participants rated both relatively serious contexts as more serious than the relatively less serious contexts (p < .05).

**Measures of purchase intent.** We measured purchase intent for each invitation blank for each of the four occasions in two ways: First, participants indicated the likelihood that they would choose each card option (A–I) on a six-point scale, anchored by “very likely” (6) and “very unlikely” (1). Because critiques of rectangular preference research find that rankings and ratings are complementary, participants also indicated which of the nine card blanks they were “most likely to choose” and “least likely to choose.” Rankings preserve interitem distances, whereas ratings are less sensitive to aggregation and scale usage effects (Green 1995; Plug 1980).

**Measure of relative seriousness of the four occasions.** Because the relative seriousness of consumer occasions has not been measured as a construct, we could not use an established scale for this purpose. Accordingly, we generated five items to measure this construct. After providing purchase intentions, participants rated each of the four occasions using five-seven-point semantic differential scales, anchored by “frivolous/serious,” “orderly/disorderly,” “unified/fragmented,” “volatile/stable,” and “rational/emotional.” We reverse-coded the first and fourth variables (frivolity and volatility) so that final item scores ranged from 1 (“relatively more serious”) to 7 (“relatively less serious”).

**Results**

**Manipulation check of context manipulation.** A factor analysis for each of the four occasions confirmed that the
five variables in the measure of relative seriousness loaded onto a single factor for each occasion (eigenvalues = 2.28, 2.86, 2.23, and 2.34 for birthday, accounting software, circus, and piano concert, respectively). We averaged the five variables to create an index of relative seriousness for each of the four occasions. This measure displayed a reasonable level of reliability for a new scale (α = .69, .79, .68, and .66 for birthday, accounting software, circus, and piano concert, respectively). A repeated measures 2 × 2 (context × replicate) analysis of variance (ANOVA) on this measure showed that participants rated the two occasions intended to be relatively more serious as more serious (accounting = 1.65; piano concert = 2.56) than the occasions intended to be relatively less serious (circus = 4.92; birthday party = 5.07; main effect of context: F(1, 121) = 895.25, p < .001). The two occasions within each context domain differed from each other (main effect of replicate: F(1, 121) = 28.80, p < .001), and this difference was greater for the two relatively more serious occasions (interaction: F(1, 121) = 70.04, p < .001).

Results for purchase intentions. To test H1a, we first analyzed the purchase intention ratings using a 9 × 2 × 2 (ratio × context × replicate) within-subjects, repeated measure ANOVA. As H1a predicted, intent ratings for cards differed by ratio (main effect: F(8, 848) = 64.18, p < .001).

Mean purchase intention ratings for each card and ratio appear in Figure 2.

The rankings data also support H1a (see Table 1). For each occasion, the number of participants who ranked each card as their first choice was contingent on the ratio of the cards (χ²(8) = 73.56, 48.45, 30.15, and 68.63 for accounting, piano, circus, and birthday, respectively; ps < .01). The number of participants rating each card as their least favorite was also related to ratio (χ²(8) = 164.29, 118.13, 105.07, and 180.44 for accounting, piano, circus, and birth-

![FIGURE 2](image-url)
day, respectively; \(ps < .01\). Thus, the purchase intention ratings and the first-choice and last-choice rankings all support \(H_{1a}\).

**Impact of context on purchase intentions.** Next, we examined whether purchase intentions for the different rectangular cards depended on whether the card was being chosen for a relatively serious or frivolous occasion. In an ANOVA of the purchase intention ratings, the main effect of ratio was contingent on context (ratio \(\times\) context interaction: \(F(8, 848) = 13.91, p < .001\)). The overall analysis also produced additional significant effects of context (\(F(1, 106) = 15.73, p < .001\)), a replicate \(\times\) context interaction (\(F(1, 106) = 4.01, p < .05\)), and a significant three-way interaction (\(F(8, 848) = 8.02, p < .001\)). The interaction effects involving the replicate factor reflect that the two relatively more serious contexts differed more in their degree of rated seriousness than did the two relatively less serious contexts. The latter effect is not of concern to our predicted effects, and thus we do not analyze it further.

The number of participants who ranked each ratio as their first choice was also contingent on the four occasions (overall \(\chi^2(24) = 71.83, p < .001\)), as was the proportion of participants who ranked each ratio as their least favorite choice (overall \(\chi^2(24) = 47.60, p < .001\)). Thus, across the three measures of purchase intentions, first choice, and worst choice, the results suggest that preferences for the different ratios of the cards depended on the relative seriousness of the occasion for which the invitation was being selected.

**Preference for a range of ratios rather than a particular rectangle.** Prior research has often found that people prefer a contiguous range of rectangles rather than a particular ratio (Benjafield 1976; McManus 1980; Piehl 1976, 1978; Svensson 1977). If this finding applies in a consumer context, it could be important to marketers and brand managers because it implies that it is less important to use a particular ratio for rectangular products and packages than a ratio in the preferred range. In Study 2, the use of nine invitations with ratios extending from 1:1 to 2:1 makes it useful for an exploratory examination of whether participants had higher purchase intents within a range of ratios. We also examine each context separately because the preferred range may differ for relatively more serious versus less serious occasions.

If consumers prefer a range of ratios within the range we used in Study 2 for the two relatively serious contexts, we would expect an inverse U-shaped pattern for the purchase intent ratings. We checked for this pattern by regressing the intent ratings for the serious contexts on ratio and ratio\(^2\) using ordinary least squares regression. The standardized beta coefficients support an inverse U shape. There is a positive coefficient for the main term and a negative one for the squared term (\(\hat{b}_{\text{ratio}} = 3.59, t = 17.39, p < .001; \hat{b}_{\text{ratio squared}} = -3.74, t = 18.12, p < .001\)), indicating that the relationship is not linear. Furthermore, the mean intent ratings for both the child’s birthday party and the circus trip do not exhibit an inverse U shape in Figure 2. Instead, the nonlinearity is driven by the combination of a plateau in the range of 1:1–1.5:1, with ratings decreasing for larger, more elongated ratios. Thus, there is evidence of a preferred and less-preferred range but not of an inverse U shape. Furthermore, the range of 1–1.5 has a higher number of first rankings than do higher ratios, but the data for the number of last rankings are less consistent. Thus, although we caution that these investigations are exploratory in nature, Study 2 provides preliminary evidence for a favored range rather than a particular favored rectangle for both the relatively more serious and the relatively frivolous contexts. Furthermore, these ranges and the shape of the relationships appear to differ across contexts.

**Discussion**

Study 2 provides additional support for \(H_{1a}\); that is, in a consumer context, purchase intentions for rectangular consumer products depend on the ratio of the rectangle. Exploratory investigations also suggest that these intentions depend on the context of the relative seriousness of the consumer occasion for which the product is used and that preferences exist for a range of ratios rather than for a particular ratio, especially in relatively serious contexts.

**Study 3: Frequently Purchased Grocery Products**

Studies 1 and 2 found that the ratio of rectangular products and packages affects consumers’ preferences and purchase intentions. A managerial implication of this finding is that ratio should also affect actual marketplace demand for rectangular products and packages. Whereas Studies 1 and 2 focused on purchase intentions and preferences, Study 3 examines actual marketplace demand for frequently purchased consumer goods sold in rectangular boxes. Given this focus on market demand, we test the following hypothesis:

\(H_2\): Marketplace demand for products sold in a rectangular box is related to the ratio of the sides of the box.

The exploratory results of Study 2 supported the notion that the relationship between purchase intention ratings and rectangular ratio was different for relatively more serious versus less serious contexts. Accordingly, we expect that the impact of ratio on marketplace demand also depends on this context. Thus, Study 3 also tests the following hypothesis:

\(H_3\): The direction of the relationship between marketplace demand, as measured by market share, and the ratio of the
dimensions of rectangular boxes is different for products used in relatively more serious versus relatively less serious contexts.

Product Categories

To test H$_2$ and H$_3$, we chose four categories of products that are sold in supermarkets in rectangular boxes. To ensure comparability across categories, we chose categories in which (1) consumers see the package as a two-dimensional rectangle on the shelf but see three dimensions when inspecting the package off the shelf, (2) package materials are similar across brands (e.g., cardboard), (3) there is within-category variation in the ratio of the rectangles, and (4) there is an external criterion to measure marketplace demand. Following the method used in Study 2, we pretested four categories that met these four criteria to ensure that two of them were perceived as relatively more serious and that two were perceived as relatively less serious. A pretest (n = 38) showed that soaps and detergents were rated as more serious (M = 4.15 and M = 4.41, respectively, on a seven-point scale anchored by “not at all” [1] and “very serious” [7]) than cereal and cookies (M = 3.26 and M = 2.93, ps < .05).

Products

We identified the top eight to ten brands in terms of market shares in each category using market share data from the Market Share Reporter (Thomson Learning 2002, pp. 273–301, 696). The average market share in the two relatively more frivolous categories was 3.53%, whereas the average for the two relatively less frivolous categories was 9.08%. We recorded the dimensions of the height, width, and length of the box for each of these brands and calculated the following three ratios for each brand:

1. Longest dimension/median dimension (max/mid),
2. Longest dimension/shortest dimension (max/min), and
3. Median dimension/shortest dimension (mid/min).

Note that the Ratio 3 is the inverse of Ratio 1/Ratio 2. Illustrations of some of the brands considered and the variation in their shelf facings appear in Figure 3.

Results

Relationship between ratio and market share. For each of the two sets of product categories—cookies and cereals versus soaps and detergents—a separate ordinary least squares regression examined the relationship between the dependent variable of market share and the independent variables of the three ratios of the dimensions. Because market shares are percentages, we transformed them into log(share/[1 – share]). The results appear in Table 2 for the two sets of categories.

The regression results were significant for both categories (Fs = 5.12 and 8.19 for less and more serious categories, respectively; ps < .05) and explained a high degree of variation ($R^2 = .490$ and .654 for relatively less and more serious categories, respectively). This supports the relationship between package ratio and market share (H$_2$).

However, the direction of the coefficients differed across the two categories, in support of H$_3$. For the relatively more serious categories, the parameter estimates for max/mid and mid/min were positive ($\hat{\beta} = 63.55$ and $\hat{\beta} = 54.05$ for max/mid and mid/min, respectively; t = 4.00 and t = 3.80, respectively, ps < .01). In the less serious categories, the coefficient pattern was reversed: The coefficients for max/mid and mid/min were negative ($\hat{\beta} = -1.23$ and $\hat{\beta} = -1.31$ for max/mid and mid/min, respectively; t = –2.81 and t = –2.82, ps < .01), suggesting that for these categories, higher market shares were associated with lower ratios (i.e., closer to a square). Although the three parameter estimates for the ratios are all significant for both types of product categories, the signs for the relatively more serious categories are always opposite those for the relatively less serious categories.

Discussion

Overall, these results suggest that in the realm of frequently purchased supermarket products, the ratios of the dimensions of a product’s rectangular box are related to its market share. However, because of the nature of the marketplace data, we do not claim to have identified a direction of causality; that is, H$_2$ and H$_3$ may be supported because “better” products are more appropriately aesthetically designed, but it may be that appropriately aesthetic ratios translate into demand in the marketplace. Regardless of the direction of causality, these results attest to the importance of considering product form in marketing strategy, as Bloch (1995) suggests.

General Discussion

Our studies found that the ratio of the sides of rectangular products and packages affects consumer purchase intentions and preferences and that these ratios are related to actual marketplace demand for frequently purchased consumer goods. Whereas prior work on rectangular preferences in psychology and aesthetics has typically examined rectangles as abstract entities, we examined preferences and purchase intentions in the specific domain of products and packages, which is of interest to marketing managers and product designers. Our results suggest that the proportions of a rectangular product or package can have a subtle yet important effect on consumers. On a more exploratory basis, we also found that rectangular ratio can affect consumer product perceptions and that the impact of ratio on purchase intentions and demand can depend on the relative seriousness of the context in which a product is used. Furthermore, consumers appear to favor a contiguous range of rectangles rather than a particular rectangle. However, we caution that before these results can be generalized, a broader set of rectangular products and packages must be tested.

Notably, many of the products we examined in the marketplace had ratios that were not highly favored in either our laboratory or our field studies. Thus, our findings, far from being conventional wisdom among marketing managers and product designers, may be able to inform the decisions of product designers and brand managers and add
<table>
<thead>
<tr>
<th>Product</th>
<th>Share (%)</th>
<th>Height (Inches)</th>
<th>Width (Inches)</th>
<th>Depth (Inches)</th>
<th>Max/Mid</th>
<th>Max/Min</th>
<th>Mid/Min</th>
<th>Area: Height × Width × Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arm &amp; Hammer Fabricare</td>
<td>3.96</td>
<td>10</td>
<td>11.19</td>
<td>6</td>
<td>1.119</td>
<td>1.865</td>
<td>1.667</td>
<td>671.40</td>
</tr>
<tr>
<td>Wisk</td>
<td>2.32</td>
<td>7.75</td>
<td>8.81</td>
<td>5.19</td>
<td>1.137</td>
<td>1.697</td>
<td>1.493</td>
<td>354.36</td>
</tr>
<tr>
<td>Ultra Tide with Bleach</td>
<td>5.49</td>
<td>8.63</td>
<td>10.88</td>
<td>6.31</td>
<td>1.261</td>
<td>1.724</td>
<td>1.368</td>
<td>592.47</td>
</tr>
<tr>
<td>Ultra Surf</td>
<td>2.06</td>
<td>6.75</td>
<td>8.75</td>
<td>5.19</td>
<td>1.296</td>
<td>1.686</td>
<td>1.301</td>
<td>306.53</td>
</tr>
<tr>
<td>Surf</td>
<td>4.94</td>
<td>8.63</td>
<td>11.25</td>
<td>6.25</td>
<td>1.304</td>
<td>1.800</td>
<td>1.381</td>
<td>606.80</td>
</tr>
<tr>
<td>Gain</td>
<td>12.94</td>
<td>8.13</td>
<td>11.25</td>
<td>6.31</td>
<td>1.384</td>
<td>1.783</td>
<td>1.288</td>
<td>577.13</td>
</tr>
<tr>
<td>Cheer</td>
<td>8.45</td>
<td>8</td>
<td>11.25</td>
<td>6.25</td>
<td>1.406</td>
<td>1.800</td>
<td>1.280</td>
<td>562.50</td>
</tr>
<tr>
<td>Tide</td>
<td>36.01</td>
<td>6.06</td>
<td>8.69</td>
<td>5.06</td>
<td>1.434</td>
<td>1.717</td>
<td>1.198</td>
<td>266.47</td>
</tr>
</tbody>
</table>
to the academic literature on product packaging (Folkes and Matta 2004; Krider, Raghubir, and Krishna 2001; Raghubir and Krishna 1999; Wansink and Van Ittersum 2003; Yang and Raghubir 2005). A brief survey of store brands showed that many private labels use a ratio that we found to be less liked. Whether this is done intentionally is an interesting area for research. We hope that by demonstrating the relevance of rectangular preferences to the consumer domain, our findings will encourage researchers to explore the aesthetic appeal of other products and packaging variables and their impact on brand image, including, but not limited to, proportion, shape, color, font, relative salience, and other visual characteristics.

Our studies do not examine whether consumers’ reactions to rectangular products and packages vary with culture or nationality. It is possible that consumers’ environments, including the range of products and package shapes in the marketplace, the architectural norms surrounding them, the media to which they are exposed, and other cultural differences across countries and people, affect their reactions to package shapes. Cultural factors may also cause the impact of relative seriousness of context to differ across people. These issues are particularly important for international brand managers who are deciding whether to use a local or global international marketing strategy and thus are a potential fruitful area for future research.

We examined how the shape of a rectangle affects product perceptions. Further research could examine additional product perceptions. A managerial implication of this finding is that companies may be able to change product perceptions by changing the shape of a product or package or by making shape more salient. It would also be interesting to examine whether product and package shape affects the sensory aspects (e.g., taste) or cognitive aspects (e.g., willingness to pay) of a product. Furthermore, Study 1 examined relatively serious contexts and the CDs for them. Additional research might examine whether the results replicate or reverse if the context is less serious, such as Cajun restaurants that encourage a fun atmosphere.

Our findings for context may help explain why prior literature on rectangular preferences has been inconclusive. As we noted previously, this research has rarely stated a context. Although participants are likely to invoke the relatively serious context of a lab experiment if provided with no other context, variations in a lab’s appearance, experimenter demeanor, and instruction wording might all affect this context factor. Furthermore, of their own accord, participants often imagine experiments that rectangles are particular objects, and there can be great variety in these objects (Ohta 1999). This could create variations in the context in which these imagined objects are used, adding an uncontrolled element to studies of preferences for rectangles.

Further research might examine whether the effects studied herein are subliminal versus conscious (and if this varies across effects) and whether they are best studied with indirect versus direct methods of elicitation of purchase intentions, preferences, or choices. It is plausible that subconscious appeals, such as aesthetic beauty, are more likely to manifest in indirect tasks, whereas more conscious and cognitive processes, such as volume estimation, may be better measured with direct tasks. Such research would be of interest given the growing interest in marketing on nonconscious processes (for a review, see Fitzsimons et al. 2002).

Our results examined how a single context, relatively more versus less serious, affects consumer reactions to rectangular packages and products. Although this context is rooted in the reasons proposed for consumers’ preferences for certain rectangles, other contexts, such as whether the product is used for utilitarian or hedonic purposes, may also affect these reactions (e.g., Chandon, Wansink and Laurent [2000] show that a sales promotion’s efficacy depends on the product type). Furthermore, additional research is needed to explore the construct validity of the serious/frivolous distinction to determine how it applies to a broader context.

### TABLE 2

**Study 3: Regression Predicting Market Shares of Frequently Purchased Grocery Products (Relatively Less Serious [Cereal and Cookies] Versus More Serious [Soaps and Detergents])**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cereal and Cookies</th>
<th>Soaps and Detergents</th>
</tr>
</thead>
<tbody>
<tr>
<td>R²</td>
<td>.490</td>
<td>.654</td>
</tr>
<tr>
<td>Number of observations</td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td>Overall F</td>
<td>5.12 (p = .013)</td>
<td>8.19 (p = .003)</td>
</tr>
<tr>
<td><strong>Coefficient</strong></td>
<td><strong>Estimate</strong></td>
<td><strong>t-Value</strong></td>
</tr>
<tr>
<td>Intercept</td>
<td>-2.19</td>
<td>-1.96 (.068)</td>
</tr>
<tr>
<td>Max/mid</td>
<td>-1.23</td>
<td>-2.81 (.013)</td>
</tr>
<tr>
<td>Max/min</td>
<td>.998</td>
<td>3.76 (.0017)</td>
</tr>
<tr>
<td>Mid/min</td>
<td>-1.31</td>
<td>-2.82 (.0122)</td>
</tr>
</tbody>
</table>

### Footnote

3Safeway, a leading grocery chain on the West Coast of the United States, offers crispy rice bars in a box with dimensions (in inches) of 24 × 12 × 6 (shelf face ratio of box = 2), unsalted top crackers in a package with dimensions of 25.25 × 11.25 × 11 (ratio = 2.24), and sugar cones in a box with dimensions 25 × 12 × 6 (ratio = 2.08). Compare this with box dimensions of leading national brands: For example, Betty Crocker’s pancake mix has dimensions of 23.5 × 16.5 × 6 (ratio = 1.42), and Orville Redenbacher’s popcorn has dimensions of 16 × 11.5 × 5.5 (ratio = 1.39).
range of consumer products. Furthermore, we did not examine contexts that may affect how carefully or accurately consumers process information regarding rectangular shapes. This processing could be affected by color, other shapes near the rectangles, or even the rectangle’s material.

Individual differences in aesthetic preferences can have an important impact on aesthetic responses to product design and shape (Bloch 1995; Holbrook 1986). Furthermore, Bloch, Brunel, and Arnold (2003) find empirical support that people differ in how important visual product aesthetics are to their “relationship with products” (p. 551); they developed a scale of the centrality of visual product aesthetics to measure this tendency, based on the dimensions of “value, acumen, and response intensity” (p. 551). Thus, an important area for further research is to examine how such individual differences may affect consumer responses to rectangular products and packages. Although gender did not have a significant impact in Study 1, it may affect the impact of rectangular ratio in other product categories. Other demographic variables also deserve study; for example, age may moderate rectangular consumer preferences if people become more serious over time.

REFERENCES


