Visual Marketing
From Attention to Action

Edited by Michel Wedel • Rik Pieters
Visual Marketing
From Attention to Action
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Introduction

Consumer reaction to products can depend on aesthetic product features and product and package design (Bloch, 1995; Holbrook & Anand, 1992; Raghubir & Greenleaf, 2006). Product designers vary aesthetic features to appeal to consumer preferences for these features and to differentiate their products from competing products. While product design incorporates many kinds of attributes, such as the taste of a cereal, the resolution of a digital camera, or the gas mileage of an automobile, one design element that must be addressed for many products is geometric shape. A product’s shape and geometry can be considered one of its most basic design features, especially from the perspective of a consumer who is viewing the product but has yet to use it. However, while research in psychology and aesthetics has paid considerable attention to perceptions of, and preferences for, different basic shapes, less attention has been given to this question in the realms of consumer behavior and marketing management.

We examine the issue of geometry in the marketplace from three perspectives. First, from an empirical perspective, we examine whether the relative seriousness versus frivolousness of a product category, which is a context effect that has been found to be related to the variation of consumer purchase intentions and preferences (Raghubir & Greenleaf, 2006), is also related to the variation of this ratio in marketplace offerings in different categories and subcategories.

Second, we propose an agenda for consumer behavior research on geometry, which focuses on marketplace concepts that are important
in consumer behavior and marketing, such as competition and post-purchase satisfaction, but have been much less studied in research on geometry. Third, we propose a broader, integrative conceptual model to serve both as a set of testable hypotheses and as a research agenda for examining geometry in design from a consumer perspective. This model unites concepts from aesthetics, psychology, and consumer behavior into a single conceptual framework. This model delineates four primary geometric properties that we feel should relate to products and packages, proposes routes through which these properties affect consumer judgments, then proposes factors moderating their effect, and then links these factors to marketing implications, for marketing decisions in the realm of the “four Ps” of the marketing mix, such as product design, placement, promotion, and pricing. As examples of how this model incorporates geometric design features, we discuss in detail planned distortion and incomplete patterns, two design features found in the marketplace.

An Empirical Test of Variation in Rectangular Ratios in the Marketplace

We begin our examination of geometry in the marketplace by giving an example of how empirical research, in this case using the positivist method, can be applied to study geometry. This section presents the results of four studies of the variation of ratios in a variety of product categories. Rectangular ratios are one of the most frequently used shapes in product and package design (e.g., TVs, cereal boxes, greeting cards, books, print advertising), and the ratio of a rectangle’s sides is one of its most salient attributes. Further, their quantifiable nature makes rectangular ratios a good starting point for examining marketplace variation in product features, especially as the results can inform one of the oldest controversies in psychology and aesthetics.

Research on Preferences for Rectangles

Aestheticians and psychologists have long been interested in preferences for rectangular ratios. Indeed, some of the earliest experimental work in psychology was Fechner’s (Fechner, 1871, 1876, trans. 1997) investigation of whether people preferred the “golden ratio”
rectangle (ratio of sides of $\Phi \approx 1.618$). Ancient Greek and Renaissance writers, as well as more recent aestheticians, have noted the special mathematical and aesthetic qualities of this number (Borissavliévitch, 1958; Ghyka, 1977; Herz-Fischler, 1987; Huntley, 1970; Livio, 2002; Pennick, 1980), and claim that it is used in the design of many admired buildings, such as the Parthenon, and recurs in natural formations such as shells and sunflowers. However, Fechner's conclusions remain controversial (Höge, 1997; Green, 1995, reviews this research). Other researchers have concluded that people prefer a range of rectangles, extending roughly from $\sqrt{2}$ (1.414) to $\sqrt{3}$ (1.732) and including $\Phi$, rather than a single ratio (Benjafield, 1976; McManus, 1980; Piehl, 1978; Plug, 1976; Svensson, 1977). In recent work, Raghubir and Greenleaf (2006) showed that the preference for rectangles over squares is contextual—it is not found for contexts that are relatively frivolous in nature. The specific underlying reason for such a preference remains a matter of conjecture, with some possible routes through which it could manifest being discussed in our conceptual model.

**Context Effects in Rectangular Preferences**

Much of the research just discussed examines preferences for abstract rectangles (though a few have examined actual objects, such as Shortess, Clarke, and Shannon [1997], who examine the ratios of paintings and discuss Fechner's work [1871, 1876] examining ratios of actual objects). However, recent research in marketing has argued that since products and packages are typically used in particular contexts, consumer researchers need to study preferences for rectangular products and packages rather than abstract rectangles, and also need to examine how consumer preferences and purchase intentions vary with the context in which a rectangular product or package is used (Raghubir & Greenleaf, 2006). This research has found that consumers' preferences for rectangular products with different ratios depend on whether the product is intended to be used in a relatively serious or frivolous context. In particular, they found that consumers preferred a tighter range of rectangles in relatively serious contexts, but that the preference range was much wider for relatively frivolous ones. The context of relative seriousness versus frivolity was chosen because many of the reasons that have been
offered in research on rectangular preferences to explain why people will prefer certain rectangles relate to properties—such as rationality, balance, harmony, proportion, and mathematical beauty (Ghyka, 1977; Huntley, 1970; Lawlor, 1982; Livio, 2002)—that are more likely to be important when consumers are in a more serious, versus frivolous, frame of mind.

Given these prior findings, we propose that the differences in variation in purchase intentions found by Raghubir and Greenleaf (2006) across the relatively serious versus frivolous contexts implies that variation in the product design feature of rectangular ratio will also depend on this context effect. Furthermore, we propose that the variation in design features will be parallel to the variation in purchase intentions. Thus, we propose:

**H1:** Rectangular ratios found in marketplace offerings in a product subcategory that is used in a relatively more serious context will have less variation than ratios for a subcategory of the same product that is used in a relatively less frivolous context.

Four studies test this hypothesis using actual marketplace offerings. One of the product categories we will study, greeting cards, is similar to the invitation card category that was studied by Raghubir and Greenleaf (2006), while two other categories, newspaper ads and books, extend this inquiry into additional categories. In all studies presented here, we sought categories where:

1. The predominant shape in the product category is a rectangle.
2. The product is two dimensional or primarily seen in two dimensions.
3. Ratios of the product dimensions in the category vary across products and brands.
4. Products in subcategories within the larger product category are used by consumers in different contexts that vary in their relative seriousness versus frivolity.

In all four studies research assistants who were blind to the hypothesis collected the data. For each study we report how we operationalized the relative seriousness/frivolousness of the context using product subcategories or brands or both, then describe the sampling method, and present the results. The analysis is an $F$ test of difference in variance across two sets of observations. Summary statistics for all four studies are presented in Table 6.1.
TABLE 6.1 Dimensions and Ratios of Marketplace Offerings, by Context

<table>
<thead>
<tr>
<th>Study 1: Individual and Business Cards</th>
<th>Study 2: Individual Humorous Birthday and Sympathy Cards (n = 40)</th>
<th>Study 3: Newspaper Advertisements by Section (n = 118)</th>
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</thead>
<tbody>
<tr>
<td>Individual</td>
<td></td>
<td></td>
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<tr>
<td>Individual</td>
<td>Width 5.62 Height 6.44 Ratio 1.36 Std. Dev. 0.17 n 30 95% Range 1.30–1.42</td>
<td></td>
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</tr>
<tr>
<td>Business</td>
<td>Width 5.79 Height 6.21 Ratio 1.43 Std. Dev. 0.04 n 30 95% Range 1.41–1.45</td>
<td></td>
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</tr>
<tr>
<td>Humorous Birthday</td>
<td>Width 5.26 Height 7.83 Ratio 1.62 Std. Dev. 0.33 n 20 95% Range 1.48–1.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sympathy</td>
<td>Width 5.35 Height 7.75 Ratio 1.45 Std. Dev. 0.01 n 20 95% Range 1.43–1.47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WSJ: All</td>
<td>Width 7.76 Height 11.10 Ratio 1.61 Std. Dev. 0.60 n 36 95% Range 1.41–1.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economy</td>
<td>Width 7.09 Height 9.26 Ratio 1.48 Std. Dev. 0.52 n 20 95% Range 1.25–1.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>Width 8.91 Height 13.69 Ratio 1.73 Std. Dev. 0.69 n 16 95% Range 1.38–2.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less Frivolous Sections</td>
<td>Width 6.81 Height 8.57 Ratio 2.39 Std. Dev. 2.11 n 82 95% Range 1.93–2.86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Front Page</td>
<td>Width 8.86 Height 10.55 Ratio 1.78 Std. Dev. 1.31 n 22 95% Range 1.22–2.34</td>
<td></td>
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</tr>
<tr>
<td>Bay Area</td>
<td>Width 6.88 Height 11.53 Ratio 1.70 Std. Dev. 0.26 n 5 95% Range 1.46–1.93</td>
<td></td>
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</tr>
<tr>
<td>Business</td>
<td>Width 9.60 Height 9.11 Ratio 1.98 Std. Dev. 1.34 n 4 95% Range 0.64–3.32</td>
<td></td>
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</tr>
<tr>
<td>News</td>
<td>Width 6.16 Height 10.05 Ratio 1.68 Std. Dev. 0.50 n 12 95% Range 1.39–1.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>More Frivolous Sections</td>
<td>Width 5.56 Height 6.56 Ratio 3.09 Std. Dev. 2.71 n 39 95% Range 2.22–3.96</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sporting Green</td>
<td>Width 6.69 Height 8.56 Ratio 3.13 Std. Dev. 2.76 n 14 95% Range 1.66–4.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Datebook</td>
<td>Width 5.45 Height 3.63 Ratio 3.94 Std. Dev. 3.77 n 9 95% Range 1.43–6.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Bay Friday</td>
<td>Width 4.62 Height 6.45 Ratio 2.58 Std. Dev. 1.94 n 16 95% Range 1.61–3.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children's Books</td>
<td>Width 7.18 Height 8.69 Ratio 1.31 Std. Dev. 0.16 n 30 95% Range 1.26–1.37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Science Books</td>
<td>Width 5.94 Height 8.65 Ratio 1.46 Std. Dev. 0.10 n 30 95% Range 1.43–1.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Note that ratio may not equal height/width due to differences in orientation in the categories.

2 95% confidence interval for mean ratio calculated as mean ratio +/−2 standard error, where standard error = st. dev. / \( \sqrt{n} \).
Study 1: Greeting Cards for Individuals versus Businesses

*Operationalization of Seriousness of Context*

Two subcategories of greeting cards, for businesses and for individuals, were chosen to operationalize the relatively less and more frivolous domains, respectively. The distinctions were based on the manner in which Hallmark categorized the cards on its website. The cards included wishes for festivals, birthday, anniversary, congratulations, and get well messages.

*Sampling Method*

Every tenth card within each subcategory (business and individual) was chosen for inclusion in the sample, based on a randomly chosen starting point in a display of greeting cards on the Hallmark website. Thirty cards were chosen from each subcategory.

*Results*

The dimensions for each card were recorded from the same website, and the ratio of the longer to the shorter side was calculated, as was the variance in this ratio. The variance of the rectangular ratios across the individual greeting cards was significantly greater than this variance across the business greeting cards (variance = .0291 vs. .002; $F(29, 29) = 14.77, p < .0001$). This is consistent with the hypothesis that there will be less variation in the ratio of market offerings for the business cards, which is the relatively less frivolous context, compared to the individual cards, which is the relatively more frivolous context, and supports H1.

Study 2: Greeting Cards for Condolence versus Birthdays

*Operationalization of Seriousness of Context*

Study 2 examined whether H1 would hold within the individual card category for card occasions for individuals that were relatively

* http://www.hallmark.com/Website/hallmark_home.html
serious versus relatively frivolous. Condolence (sympathy) and humorous birthday cards were chosen to represent the relatively more serious and relatively more frivolous contexts, respectively. A pretest ($n = 39$) established that birthday cards are perceived to be relatively less serious ($M = 3.33$ on a 1–7 scale anchored at “1 = Not at all” and “7 = Very” serious) than condolence cards ($M = 5.33$, paired $t (38) = 6.55$, $p < .001$).

**Sampling Method**

Twenty cards from each subcategory were selected at random from a Hallmark display in a grocery store in a West Coast city. Cards were selected by choosing a starting point at random and then counting every tenth card, repeating through the selection as necessary to obtain twenty cards per subcategory.

**Results**

As predicted by H1, the variance of ratios for the relatively more serious condolence cards was smaller than for the relatively less serious birthday cards (variances = .000086 and .1069; $F (19, 19) = 1173.8$, $p < .0001$), and its range of ratios was smaller (range = 1.43–1.47 vs. 1.22–2.31 for condolence vs. birthday cards respectively).

**Study 3: Newspaper Display Ads**

**Operationalization of Seriousness of Context**

Study 3 examined newspaper display ads appearing in two newspapers on a specific day. We operationalized the seriousness of context for newspapers by choosing a business newspaper, the *Wall Street Journal* (WSJ), to represent a relatively less frivolous context, and a family newspaper, the *San Francisco Chronicle* (SFC), to represent a relatively more frivolous context.

Further, the SFC is divided into seven different sections that vary along the serious/frivolous dimension. Four of these sections—Front
Page, Bay Area News, News, and Business—are relatively more serious in their content, while three other sections—Datebook (movie and TV listings and articles, social gossip, and horoscopes), Sporting Green, and East Bay Friday—are relatively more frivolous. This gives the opportunity to test H1 both across the two newspapers and across the sections of the SFC.

Results of a pretest conducted with undergraduate students in the San Francisco Bay area ($n = 41$) showed that overall newspapers (as a category) are rated 5.23 on a 7-point scale with higher numbers indicating greater seriousness. The SFC, as a whole, is rated as less serious than WSJ ($M = 4.52$ vs. $6.50$, $t(40) = 5.72$, $p < .01$). Further, each of the four sections classified here as relatively serious was rated as more serious ($M = 5.24, 4.85, 5.30$, and $5.16$ for Front Page, Bay Area News, News, and Business, respectively), than each of the three sections categorized as less serious ($M = 3.73, 2.90$ and $2.78$ for Sporting Green, Datebook, and East Bay Friday, respectively, $p < .05$).

**Sampling Method**

The number of display ads ($n = 118$) was small enough to permit a census of all advertisements beyond a given size. There were a total of 36 display ads in that day’s WSJ and 82 ads in the SFC. A Friday newspaper (October 19, 2001) was selected in each of the two categories. The section (e.g., Economy, International in WSJ), page number, height, and width of each ad were recorded.

**Results**

The SFC ads had a higher variance (range = 1.02–9.56, variance = 4.45) than the WSJ ads (range = 1.05–3.70, variance = .36; $F(81, 35) = 12.33, p < .01$). Further, ads in the relatively more frivolous sections of the SFC had a higher variance (7.36) than those in the less frivolous ones (variance = 1.07 $F(38,42) = 6.91, p < .0001$). Therefore, H1 was supported both across different newspapers and across sections of the same newspaper.
Study 4: Books

Operationalization of Seriousness of Context

In a bookstore, the categories “Children’s Books” and “General Science Books” were chosen to represent the relatively more and less frivolous contexts respectively. A pretest ($n = 39$) showed that children’s books are rated as less serious than science books ($M = 2.54$ vs. $5.00$, $t(38) = 7.64$, $p < .001$).

Sampling Method

Thirty books were selected from each subcategory. We chose a starting point at random and then selected every tenth book title, repeating as necessary to obtain a sample of 30 books. The ratios of the sides of each book’s cover were taken from dimensions provided on the Amazon.com website. These dimensions appeared on the same web page that described the book and contained a picture of the cover.

Results

The variance in the ratio of the sides was higher for the children’s books (0.025) than for the science books (0.009; $F$ tests for unequal variances, $p < .01$). The range of ratios of children’s books was also wider (1.00–1.64) than the range of science books (1.13–1.57).

To summarize, four studies found convergent evidence that rectangular ratios found in marketplace offerings in a product subcategory that is used in a relatively more serious context have less variation than ratios for a subcategory of the same product that is used in a relatively less frivolous context. This section is illustrative of the manner in which specific research questions can be derived from the conceptual model and tested empirically.

A Proposed Research Agenda

The geometry of products and packages may affect marketplace phenomena that are of interest to marketers and consumer researchers
but which have been less studied in the research examining geometry from the perspective of psychology and aesthetics. Next, we discuss an agenda for research on geometry in the marketplace, intended to fill some of the gaps.

Geometry and Competition

Most perceptual experiments do not ask participants which stimuli they wish to see. However, consumers typically form consideration sets of competing products, which omit many products, and then choose from the consideration set. If competing products have different geometric features, marketers need to consider which features tend to motivate consumers to include the product in their consideration set, and then choose that product over competitors in the set. One interesting area for research is to determine how different designs compete. For example, if some products share a geometric feature, does this make consumers more likely to choose a product that shares the common feature, or one that differs from the others? An analogous situation has occurred with personal digital music players. Apple’s iPod uses a very simple design, featuring subtly rounded corners and a prominent circle, to differentiate itself from its competitors. Previously Apple differentiated iMac computers by their unusual hemispherical shape. However, not all of the geometric designs in products associated with Steve Jobs, Apple’s CEO, have succeeded. In the late 1980s Jobs helped design the NeXT personal computer, a distinctive black cube, which was not commercially successful.

Marketers might also examine how different shapes compete with each other on both an abstract level and when applied to particular products. For example, if an iPod’s design features a rectangle with rounded corners and a circle inside, is the best design strategy for a new competing product to use a similar design, or to use a rectangle with different proportions, or introduce an oval or triangular product? Or might an entirely new shape, such as one with two basic shapes superimposed over each other, such as a circle over a rectangle, be more successful? Suppose that the missing part of a shape that the consumer must mentally supply was subtly reproduced on a firm’s logo. Would this increase a product’s appeal, since the consumer has mentally generated the same shape that the corporation uses?
Mental Processing of Geometry

While considerable research exists on how consumers process information for most product attributes, research on geometric shapes has focused on preferences for these shapes, and not on how people gather information to arrive at those preferences. Research on rectangular preferences has only examined this question occasionally. For example, Ohta (1999) proposed a model of “the decision process of preferred quadrangle shapes” (Ohta, 1999, p. 515) that included stages of “imagining concrete objects” and “transformation of the figure [quadrangle].” He used eye tracking and interviews to obtain a richer perspective on how people process information from simple quadrangle figures. Ohta found that while some participants always treated quadrangles abstractly, others attempted to impose concrete identities on them, such as bathtubs, windows, or even a basketball court. Some participants switched between abstract and concrete modes.

The eye tracking methodology used by Ohta has appeared in several applications in consumer behavior (Lohse & Johnson, 1996; Russo & Leclerc, 1994; Wedel & Pieters, 2000), as have interview techniques. Neither has been applied to study geometry in product design, however. While Ohta limited his study to simple shapes, marketers might examine how people process two- and three-dimensional shapes when they are told what category the product belongs to, or are given other information relevant for consumer behavior. For example, will consumers process geometric shapes differently if they are told that the product is a dish as opposed to a lamp? Suppose it is an expensive dish versus a cheap one, or a product in a relatively new category, such as an e-book, versus a relatively mature product such as a cell phone?

Consumer behavior researchers have also given attention to conscious versus unconscious, or “automatic,” processing of information. (Fitzsimons et al., 2002). Based on Ohta’s (1999) results, it is apparent that at least some processing of geometric shapes takes place on a conscious level. However, it seems likely that much of this processing is automatic, especially when information on shapes is processed concurrently with information on other attributes.
Reducing Cognitive Effort for Processing Shapes

Consumers often prefer products that reduce the need for cognitive effort. Marketers might want to avoid shapes that require effort to fill in missing pieces or patterns. However, consumers may not prefer that product designers complete patterns that the consumer brain usually must complete. Zeki (1999, ch. 6) discusses how cubist artists tried to show, on a single, painted plane, what a viewer can only see from multiple perspectives. Zeki considers cubism to be unsuccessful, concluding that “The brain of course regularly views objects and people from different angles, but it is able to integrate these different views in an orderly way....The attempt by cubism to mimic what the brain does was, in the neurobiological sense, a failure” (p. 54).

Our point here is not whether or not one should agree with Zeki (he acknowledges that many people would disagree), but rather that his conclusion raises the question of whether design variations intended to do the work of the brain will succeed. For example, Picasso’s more demanding cubist works tend to sell for less at auction than his compositions that portray a subject more realistically, such as early works from his Blue and Rose Periods, even though the latter are not the works that made his reputation as a revolutionary artist. Consumer reactions to product designs that simplify processing may be different for more functional or utilitarian products compared to works of art, so we consider the question of how design might facilitate processing of shapes to be far from answered.

PostPurchase Experience

Consumer behavior is also interested postpurchase experience, which is a key determinant of satisfaction, brand loyalty, and word-of-mouth behavior. Studies of geometry in aesthetics and psychology, however, almost all end when the experimental session ends—participants are not asked to take a shape home and report back in a week on their intent to buy or recommend it.

Perhaps the most interesting research opportunity in this respect is whether a product’s geometric design creates performance expectations that can affect postpurchase satisfaction. For example, some computer keyboards place the numeric keypad in a second keyboard distinct from the main keyboard, which changes the usual 3:1 keyboard
ratio to two rectangular keyboards, one larger and horizontal with a ratio of about 2:1 and a smaller, vertical one with a ratio of about 2:1. While the keyboards are separated for ergonomic reasons—left- and right-handed people can choose where to place the keypad, and the mouse can now be placed closer to the letter keys—consumers might perceive that the unusual rectangular dimensions are also related to other product differences, such as quieter keys.

Second, if a product is used at home, consumers may pay attention after purchase to how it fits with other shapes. A microwave oven with a distinctive oval shape might appeal to consumers in a store, but seem jarring once placed alongside other products in a kitchen. Alternatively, the distinctive microwave might help transform the appearance of other kitchen objects and make them more appealing. General Electric recently introduced a 6-foot wide refrigerator that changes the usual vertical rectangular profile to a square. Such a ratio is quite unusual for a refrigerator. No doubt many customers for this appliance may anticipate that it will radically improve the look of their kitchen, creating high expectations that the refrigerator may not be able to meet for some people. One recent buyer of a 48-inch-wide refrigerator was described as “taken aback at the size when it was delivered several weeks later,” and was quoted as saying “I thought, ‘What have I done?’” (Schaefer, 2006).

Can changes in design intended to improve consumer perceptions compensate for other product changes that lower utility? One well-known U.S. orange juice company recently replaced some of its 16-ounce “milk carton” cardboard containers with a new plastic container, shaped like a hemisphere placed on top of a cylinder. Less obvious is that the contents were reduced to 14 ounces.

Processing of Product Shapes

If even a small lip is placed around a plain clay pot, its appearance can be much different, due to the increased complexity. As a product becomes more complex, consumers may paradoxically perceive it in a more simplified form. Researchers disagree over whether people tend to perceive an object or shape using simplified interpretations, termed the simplicity principle, or using more complex, but more likely, interpretations, termed the likelihood principle (Hatfield & Epstein, 1985, see van der Helm, 2000, on reconciling these two principles).
Without taking sides in this debate, we feel that the question of how consumers perceive product designs is worth examining. For instance, in the example of the square refrigerator, consumers using a likelihood principle are likely to be more confused by this design than those using a simplicity principle. Even when product design uses very complicated shapes, it is useful to know how consumers are processing those shapes. For instance, do consumers looking at an iPod perceive the rectangle, the circle, or both? Questions of simplicity versus likelihood may be most important for consumers’ first impressions of products, formed before they may know a product’s attributes, or even its product category. Marketers may want to know if it is more advantageous to appeal to simplicity or likelihood, or if consumers can be segmented based on which approach they use.

An Integrative Conceptual Model of Consumer Response to Geometry

While we feel that it is useful to study how geometry in design affects factors of interest in the marketplace, many fruitful research opportunities lie with a broader and more integrative conceptual approach that does not draw boundaries between consumer behavior and other disciplines. Here, we present a conceptual model of consumer response to geometry that, while including concepts from consumer behavior, also draws from concepts in art, architecture and aesthetics. This model is intended both as a conceptualization of how consumers respond to geometry and as a starting point to encourage cross-disciplinary work in the area of response to geometry that includes the consumer realm but is not exclusive to it. This model delineates:

1. Primary geometric properties (complexity, curvature, congruence, and completeness)
2. Routes by which they affect consumer judgments (attention, affect, and inferences)
3. Factors moderating their effect (consumer context and individual differences)
4. Types of consumer judgments (perceptual, sensory, cognitive, affective, and conative)
5. Marketing mix implications (for product design, placement, promotion, and pricing)
The model is depicted in Figure 6.1 and summarized below. The model proposes that:

1. Geometric properties affect:
   a. The amount of attention that is directed to an object or figure; and
   b. The production and delivery costs of a product.
2. The extent to which the geometric properties affect attention is moderated by two sets of moderating constructs: the consumer context and individual differences.
3. Attention, in turn, affects both the affect aroused by an object, as well as the inferences drawn about it.
4. The extent to which attention leads to affect is moderated by the consumer context.
5. The extent to which attention leads to different types of inferences is moderated by individual differences.
6. Affect associated with an object also translates into inferences drawn about that object.
7. The level and type of affect, and the types of inferences drawn, together affect consumer judgments.
8. The production and delivery costs of a product (affected by geometric properties) translate into marketplace offerings, contingent on consumer judgments (which are also affected by geometric properties).
9. The model contains feedback, inasmuch as marketplace offerings, in turn, affect the consumer context.

The model is proposed as a set of testable hypotheses delineating constructs and paths that can serve as a guide map for future research interested in examining the implications of geometry for marketplace offerings from a multidisciplinary perspective. It is not comprehensive, but more suggestive of the manner in which the shape and form of objects can affect marketplace offerings through multiple routes. It is conjectural in nature, albeit falsifiable through future empirical testing.

Geometric Properties: A Proposed Categorization

We propose that there are four main categories of geometric features: their complexity (including their dimensionality, form, regularity, and clutter), curvature (including their circularity, angularity, and convergence), congruence (including symmetry, stability, and centrality), and
Figure 6.1  An integrative conceptual model of consumer response to geometry.
completeness (including synthesis and amount of information). These primary geometric properties may not be of equal abstraction level. Some argue that curvature is a basic perceptual feature (preattentively attracting attention; Wolfe, 1998), while complexity may be a higher order perceptual dimension encompassing various more specific dimensions. Each of these is briefly defined below:

1. **Complexity:** Complexity pertains to the number of different measures that need to be used to completely describe a shape. We propose that there are four aspects of complexity:
   - **Dimensionality:** We propose that two-dimensional shapes (e.g., squares and circles) are less complex than three-dimensional ones (e.g., cubes and spheres), holding other aspects of the shape form constant. A shape that changes form across time can be thought of a four-dimensional shape (e.g., an undulating wave), and is more complex than a three-dimensional shape.
   - **Form:** The most common form categories for regular geometric objects are round (circle, sphere, and cylinder), triangular (triangles, pyramids), and rectangular (square, rectangle, and hexahedrons such as the cube and cuboid). Examples of other form classes include the five Platonic Solids: cube, tetrahedron, octahedron, icosahedron, and the dodecahedron. These shapes can be described in terms of their number of vertices (V), faces (F), and edges (E), with these three related as per Euler’s Formula V + F = E + 2. For example, the tetrahedron has 4 vertices, 4 faces of a triangular shape, and 6 edges, while the dodecahedron has 20 vertices, 12 faces of a pentagonal shape, and 30 edges. We propose that the fewer the faces, vertices, and edges, the less complex the geometric form. By this definition, the sphere with one face, and no vertices or edges, is the least complex form, with both its circumference and volume described by a single parameter: its radius.
   - **Regularity:** Regularity pertains to whether a shape follows a strict geometric pattern or whether it deviates from it, thus requiring additional parameters to capture its shape, volume, and circumference. For example, a can is a cylinder that is a regular shape defined by its radius, while most bottles have an elongated neck of a different radius than their body, requiring their volume/circumference to be described using at least two radii, and therefore, being more complex than a simple cylinder.
• **Clutter:** The clutter or simplicity of a shape or pattern is defined as the number of lines required to capture it (or the amount of matter in a given space). The greater the lines (matter), the greater the clutter in the shape (space). This concept of clutter derives from feng shui, the ancient Chinese philosophy of wind and water with implications for aesthetics and energy. For example, a pattern that has many lines and shapes is more cluttered than one with fewer lines and shapes. A website with fewer icons is less cluttered than one with many; a store space with fewer displays placed far apart is less cluttered than one which is crowded.

2. **Curvature**

• **Angularity:** Another aspect of geometric shapes is their angularity, ranging from a dot (360 degrees), to a straight line (180 degrees), to obtuse (> 90 degrees), right (90 degrees), and acute (< 90 degrees) angles.

• **Circularity:** The lack of angularity defines the circularity of a geometric shape. The extent to which the circularity is constant through the shape (as in a sphere) or changes (as in a cone) is defined as the complexity of its circularity.

• **Convergence:** The extent to which a shape converges (as does a circle) or diverges (as does a spiral) is another aspect of its geometric shape.

3. **Congruence**

• **Symmetry:** Symmetry is defined as “Exact correspondence in size and position of opposite parts; equable distribution of parts about a dividing line or center.” When the object remains symmetrical when the dividing line or plane is rotated, this is referred to as rotational symmetry. Thus, a circle is rotationally symmetric, while an ellipse is symmetric only along its horizontal and vertical axes. In a geometric sense, we further define symmetry as the ratio of the proportions of the sides of a figure. When they are equal or in a 1:1 ratio, we refer to the figure as symmetric, while when they deviate (e.g., in the ratio of 1:1.618), we capture this under the extent of asymmetry in the figure. For example, this property was explored in greater detail in the empirical section, where we examine marketplace variations in the ratios of rectangular products. A specific example of symmetry is planned distortion, discussed next.

• **Planned Distortion:** Often product designers intentionally distort a shape or package. Although planned distortions have

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received attention from psychologists and aestheticians, they have received little attention in marketing, yet deserve study. Planned distortions typically reduce actual congruence. Sometimes, however, planned distortions can increase the congruence perceived by the human eye, by correcting for irregularities in human vision. For example, if the sides of an object are truly parallel and straight, they will appear to be bowed slightly inward. If the sides are bowed slightly outwards, a practice known as *entasis*, they will appear parallel. As another example, if the vertical axes of architectural columns are truly parallel, they appear to diverge slightly, which can make a structure appear less attractive, and less solid and able to bear weight. This apparent divergence can be corrected by making the columns tilt in slightly. Both entasis and inward tilt were used in many Doric Greek temples, including the Parthenon. The centerlines of the columns of the Parthenon’s front facade tilt inward slightly, and meet approximately 7,000 feet above the ground. Greek Doric architecture employed many other planned distortions, such as tapering columns and slightly domed floors (Lawrence, 1973, ch. 15; Haselberger, 1999, on the use of curvature). Interestingly, later Greek architecture exaggerated many of these planned distortions, such as entasis, so they became an observable characteristic of buildings. Some commentators have criticized this as a “coarsening” of Greek architecture (Lawrence, 1973, p. 171), but other motives for the change are possible. For example, later Greek architects may have exaggerated planned distortion to help establish a design identity distinct from earlier architects. This question is of interest to marketers and consumer behavior researchers as an historic example of planned distortion. Entasis is not just an historic design artifact, however, it is used today in the grille of the Rolls-Royce automobile, and in beverage cans whose sides are slightly bowed out.

- **Stability**: The lower the center of gravity of an object, the greater its stability. Thus, conical shapes are more stable than cylinders, and pyramids more stable than cuboids. In a two-dimensional space, the center of the shape would define its stability in an analogous manner.

- **Centrality**: The extent to which an object is positioned close to the center of gravity of its frame is defined as its centrality. For example, the placement of a person or product in the center of an array affects perceptions of how good that product/person is, and, therefore, affects the manner in which positive and negative information about that entity are processed: errors
made by people in the center of an array are overlooked as compared to errors made by people at the extremes of an array (Raghubir & Valenzuela, 2006).

4. Completeness

- **Synthesis:** The extent to which subsegments of a shape reflect each other in a symmetrical way and join to form another shape is defined as the synthesis of the shape. For example, the yin and yang reflection within a circle is an example where two disparate halves synthesize into a whole. A square divided into two triangles is another example of two different shapes that synthesize into a square. One of the neatest examples of synthesis is the proof of the Pythagorean Theorem by Bhaskara (an Indian mathematician born in A.D. 1114) where four equal right-angle triangles circumscribe a square within a larger square (see Huntley, 1970, p. 85).

- **Amount of Information and Incomplete Patterns and Shapes:** The extent to which a shape or pattern is complete versus incomplete is defined as the amount of information it contains. Incomplete patterns and shapes are a particularly interesting feature to examine. Research on perceptions of geometric forms has found that if people view only part of an overall pattern, they will mentally fill in the remainder of the missing pattern based on their expectations of what the missing piece looks like. For example, Boselie (1984) finds that the golden ratio is preferred only when different parts of a pattern create this ratio in relationship to each other. Bouleau (1963/1980) presents an analysis of Mondrian’s “Painting I” (Museum of Modern Art, New York) that shows how the artist used the golden ratio in a larger overall pattern, only part of which is included in the painting itself (see Boselie, 1992, for a use of Bouleau’s analysis of “Painting I”). Research on perceptions of missing pieces of forms and patterns has drawn the distinction between local completions, where mental reconstruction of the missing piece depends only on features near the area that must be reconstructed, and global completions, where this reconstruction depends on overall features, including those distant from the reconstructed area. Researchers have also examined perceptions of complete shapes that are blocked or occluded by another shape (van Lier & Wagemans, 1999). Interestingly, Bouleau’s (1963/1980) analysis of “Painting I” assumes that two superimposed shapes are optically (or at least cognitively) transparent, so that they do not block each other, and the viewer simultaneously sees the edges and patterns of both shapes. Pattern incompleteness can affect
the popularity of works of art. In “Eel Spearing at Setauket,”
(New York State Historical Association, Cooperstown) by the
American artist William Sidney Mount, the long handle of the
eel spear held by the fishing woman in the bow combines with
the boat in which she stands to make two sides of a triangle. The
viewer must complete the third side. The completed triangle
contributes to the painting’s stability—the scene feels calm and
unhurried, and we feel assured that the young man in the stern
keeping the boat stable with his paddle will maintain control.
The woman will not topple. Many Renaissance paintings use
subtly pyramidal compositions involving incomplete patterns.
Raphael’s “Madonna of the Chair” is still a favorite with con-
sumers, and appears on countless plates and wall plaques pur-
chased by tourists visiting Italy.

When patterns are more complete and evident, art may lose
its appeal. The boxing pictures that the American artist George
Bellows created early in his career, such as “Both Members of
this Club” (National Gallery, Washington, D.C.) and “Stag and
Sharkey’s” (Cleveland Museum of Art), both from 1909, are
among his most well-known works, with an unsettlingly honest
depiction of brutality and violence that lives up to Bellows’s
oft-quoted statement that “I don’t know anything about
boxing. I’m just painting two men trying to kill each other”
(Peck, 2001). In 1918, Bellows’s became greatly influenced by
Jay Hambidge’s (Hambidge, 1926/1967) artistic philosophy
of “Dynamic Symmetry,” which featured an overtly geometric
treatment of composition (Braider, 1971). The later boxing
pictures that Bellows painted, such as “Dempsey and Firpo”
from 1924 (Whitney Museum of American Art, New York)
have more obvious geometric patterns. However, this use of
almost complete patterns, such as in the triangular stance of
Luis Firpo knocking Jack Dempsey through the ropes in the
first round, creates a static composition that lacks the visceral
feel of the earlier boxing paintings.

Product design often requires consumers to mentally recon-
struct missing or occluded shapes and forms. For example,
what kind of inferences do people draw about the rest of a
car, based on the part that they can see? Beginning with the
1949 Cadillac, and continuing to the early 1960s, car designers,
particularly in the United States, placed tailfins on the rear of
cars, which were so large that they were visible from the front.
The tailfins reduced the need for consumers to mentally recon-
struct the rear parts of the car.
Constructs Mediating the Effect of Geometric Properties on Consumer Judgments

We propose that there are three mediating constructs through which geometric properties affect consumer judgments. Attention, which in turn affects both affect and inferences, with affect also exerting an independent influence on inferences. Affect and inferences, then, both influence consumer judgments.

1. **Attention**: The extent to which the human eye is consciously or otherwise drawn to a particular object and the manner in which it processes the information contained in the object. For example, whether an object is noticed or not is a function of the amount of attention directed to it (see Folkes & Matta, 2004, for an example of the manner in which unusual shapes attract more attention than regular ones). Further, the process by which attention is directed pertains to what specific aspect of the object attracts attention more or earlier than others (see Wedel & Pieters, this volume, for a model of attention).

2. **Affect**: The feelings and emotions associated with an object are defined as affect. For example, the extent to which a rectangular product or package cues the feeling of harmony (Raghubir & Greenleaf, 2006), or the yin-yang symbol cues the feeling of peacefulness, would be categorized in terms of the affect generated by a geometric shape. These feelings can also translate into inferences.

3. **Inferences**: The thoughts and beliefs associated with an object are defined as the inferences drawn from the object. For example, the extent to which a circle is perceived to be “warm,” a triangle “stable,” a square “unexciting,” or a kite “fun” may all be captured in terms of the inferences that people draw from the shape of certain items. The inferences can be feeling-laden or affectively-tempered as above, but need not be. For example, an inference of “expensive” or “luxury,” for a long-necked bottle as compared to a squat one may be based on preexisting beliefs regarding costs of production or based on the shape priming another figure that is associated with the inference in question.

Factors Moderating the Effect of Geometric Properties on Attention and the Effect of Attention on Affect and Inferences

We propose that the extent to which a geometric property affects attention is a function of the consumer context and the individual
within that context. Further, these two sets of factors also influence the extent to which and the manner in which attention translates into affect and inferences.

1. Individual Differences
   - **Schemas**: These are defined as preexisting beliefs regarding the relationship between two (or more) constructs. In the context of geometric shapes, a schema could be that “those who sit in the middle are more important,” (Raghubir & Valenzuela, 2006), which could lead to inferences regarding centrality of placement on prior perceptions of quality of an entity. These schemas could also affect processing fluency, which could itself bring with it affective and inferential consequences (see Schwarz, this volume).
   - **Knowledge**: The extent to which individuals have specific information regarding a product, the less likely it is that they will use other information, such as geometric shapes to draw inferences about the aspects of that product (Alba & Hutchinson, 1987).
   - **Processing Style**: The more visual (versus verbal) the processing style and preference of individuals, the greater should be the effect of geometric features on attention and the follow through of attention to inferences (Pham, Meyvis, & Zhou, 2001).

2. Consumer Context
   - **Amount of Information**: The greater the extent to which information regarding the judgments is readily available in the consumer context (e.g., information about quality, price, etc.), the lower should be the effect of geometric features.
   - **Point of View**: The angle of view, including the larger context could also affect the amount of attention and the manner in which it is employed. For example, aerial and frontal views may provide different amounts of information and perspectives on a product (see Meyers-Levy & Peracchio, 1992, for an example of how the angle at which a picture is taken affects judgments regarding the product, with more favorable judgments when the photographer perspective is upwards rather than downwards).
   - **Frames**: The visual frame (defined in terms of the same geometric features as the object itself) may also affect the amount of attention directed to an object and the feelings aroused by it. For example, Meyers-Levy and Zhu (this volume) show how ceiling height affects creativity.
• **Resource Availability:** The extent to which consumers have the cognitive resources available to make judgments and correct these judgments if required may also affect the manner in which geometric properties translate into consumer judgments (see Raghubir, this volume, for a model of what resource availability leads to what type of information processing method).

• **Product Use:** The context in which the consumer uses the product may also affect the consumer impact of geometric features. For example, the relative seriousness versus frivolousness of the occasions for which a product is used or purchased, which was studied earlier in this paper, may also affect the relationship between attention and affect, and may be affected by the range of offerings in the marketplace.

**Consumer Judgments**

We consider implications of geometric properties for five categories of consumer judgments with examples for each.

1. **Perceptual:** Perception involves visual cues and is a process by which the eye processes information (see chapters this volume by Janiszewski, Pieters & Wedel, Rayner & Castelhano, and Tavassoli).

2. **Sensory:** Sensation involves the processing of information by senses other than sight, including taste, smell, touch, and sound. Open questions are whether the geometric shape of a product would influence its taste, or other sensory properties. For example, does the shape of a perfume bottle affect how consumers believe it smells on them?

3. **Cognitive:** Cognitive judgments include beliefs regarding the product, such as its size. They could be based on perceptual inputs such as its length (see Krishna, this volume for a review).

4. **Affective:** The feelings associated with a shape, moods, and emotions may all be affected by geometric shapes. The ancient concept of *feng shui*, has for many centuries proposed that specific aspects of a spatial arena affect various aspects of the human interacting within that arena, and is commonly used in architectural contexts in Asia (especially China, Korea, Japan, and Taiwan).

5. **Conative:** Finally, actions, such as purchase intentions, and choices could also be affected by geometric shapes (for examples of different actions and choices, see chapters this volume by Chandon, Hutchinson, Bradlow & Young, Cho, Schwarz & Song, Meyers-Levi & Zhu).
Marketing Implications

The main implication of the model is that geometric properties affect marketplace offerings through two routes: directly via costs of production and delivery, and indirectly, via their influence on consumer judgments. While the former is possibly well known to manufacturers and retailers, it is the latter that could lead to either synergistic or counterproductive effects.

1. Production Costs: The effect of shape on costs of production is dictated by the shape of the raw material used, and the volume desired. The shape that minimizes wasted material would be the most cost effective. Thus, given a square sheet, squares, rectangles, and triangles would be more cost effective to cut out of the square sheet than circles and ovals. It is possible that the use of the golden ratio in marketplace offerings also traced back to its unique geometric property that cutting a square from a golden rectangle left another golden rectangle. Thus, for manufacturers interested in manufacturing multiple sizes of the same shape of product (such as stationery), the use of the golden rectangle could have been cost effective. The fact that it may also be aesthetically pleasing is a separate issue.

2. Marketplace Offerings: Below, we list some possible implications for marketing in terms of tactics involving the “four Ps” of the marketing mix:
   - Product Design: packaging and shape
   - Placement: store layouts and design
   - Promotion: web pages and advertisements: their size, placement, etc.
   - Pricing: amount to be charged, volume discounts across different shapes that belong to the same or different product categories.

The extent to which costs of production and consumer judgments translate into actual products, in turn, will affect the consumer context.

To summarize, this section has presented a conceptual framework to examine the effect of geometric features on consumers and marketplace offerings. This framework has taken a broad, integrative approach, using concepts from aesthetics and psychology as well as marketing. Our objective has been to not only pose some testable hypotheses, but also to encourage and promote researchers in all of these fields to take a multidisciplinary approach in studying the impact of geometry on consumers.
Conclusions

Geometry plays a key part in many product designs. Here, we have proposed that consumer behavior research can benefit from studying more closely consumer reactions to geometry. We have provided an empirical example of how such studies can link to the existing literature from aesthetics and psychology to help explain variations in design in the consumer marketplace and how these are affected by context—in this case, the relative seriousness versus frivolity of the occasion a product is used for.

However, research that fully addresses consumer behavior and marketing questions must incorporate issues particular to these fields. We have proposed an agenda for research on geometry in consumer behavior and product design that incorporates some of the issues, such as the competitive nature of consumer choice and the importance of the postpurchase experience. This agenda is not meant to be exhaustive. There are many other issues of concern in consumer behavior and marketing that are usually not investigated in work in psychology and aesthetics.

We have also proposed a broader model of how consumers may be influenced by geometry, which we hope will encourage other researchers to examine these kinds of questions both from a broad perspective that should have the greatest potential to yield new and exciting findings. This model combines concepts from psychology, aesthetics, and marketing, and urges a multidisciplinary approach to the study of geometry’s impact on consumers. Although these three fields are often regarded as disparate, they are often very closely linked.

For example, the paintings and works of architecture so often studied in aesthetics, and often used as stimuli in psychology experiments (albeit sometimes in a more abstracted form), were originally created as consumer products. The artists who made them were often very concerned with how the reaction of the marketplace might affect their reputation, their standing among collectors who might purchase their work or individuals and civil and religious entities who might commission future works, and the prices they could command in a competitive marketplace. An oft repeated story that bears out this point is that Michelangelo, upon hearing that admiring visitors believed that his masterpiece, the *Pieta* (a notably pyramidal composition) was sculpted by another artist, stole in at
night to where the sculpture was displayed and carved his name on the Virgin's sash. Whether this story is true or was fabricated by Michelangelo's admirers (or detractors?), it illustrates the importance of consumer issues in even the most revered works of art.

In sum, we have studied consumers and geometry by beginning with a more conventional empirical study and broadening to a more conceptual proposal for research in this area, and to an integrative conceptual model of how consumers react to geometry, and how geometry can affect the marketplace. In a time when firms are placing increasing attention on consumer design, we hope that these efforts will encourage researchers to give more attention to geometry as part of the consumer milieu, just as Michelangelo drew attention to his own work half a millennium ago.

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