Rik Pieters, Michel Wedel, & Rajeev Batra

The Stopping Power of Advertising: Measures and Effects of Visual Complexity

Advertising needs to capture consumers' attention in likable ways, and the visual complexity of advertising plays a central role in this regard. Yet ideas about visual complexity effects conflict, and objective measures of complexity are rare. The authors distinguish two types of visual complexity, differentiate them from the difficulty of comprehending advertising, and propose objective measures for each. Advertisements are visually complex when they contain dense perceptual features ("feature complexity") and/or when they have an elaborate creative design ("design complexity"). An analysis of 249 advertisements that were tested with eye-tracking shows that, as the authors hypothesize, feature complexity hurts attention to the brand and attitude toward the ad, whereas design complexity helps attention to both the pictorial and the advertisement as a whole, its comprehensibility, and attitude toward the ad. This is important because design complexity is under direct control of the advertiser. The proposed measures can be readily adopted to assess the visual complexity of advertising, and the findings can be used to improve the stopping power of advertisements.

Keywords: attention, complexity, advertising, eye-tracking, stopping power

Advertising needs to stop consumers and hold their attention in likable ways: "Where the eye stops, the sale begins."[1] Because of rising media noise due to competing advertisements and active ad avoidance by consumers, it has become increasingly challenging for firms to attain this goal. To increase the stopping power of advertising, one school in advertising emphasizes simplicity (Aitchinson 1999; Book and Schick 1997); this school advises advertisers to "always use professional-looking, clutter-free design."[2] The idea here is that complexity hurts advertising because it makes people pay less attention to the brand and ad message and, in general, is disliked. Another school in advertising endorses complexity because it "slows down the reader, making things more difficult to take in" (Nelson 1985, p. 115; see also Chamblee et al. 1993; Putrevu, Tan, and Lord 2004); this school advises advertisers to "forget minimalist Web design: cluttered pages aren't that bad."[3] The idea here is that complexity helps advertising because it makes people stop and pay more attention to the brand and message, and people may like the challenge in accomplishing this. The verdict regarding whether ad complexity hurts or helps the stopping power of advertising is still out, however.

Academic research has examined visual complexity effects on attitudes and other downstream effects under forced, long exposures (Cox and Cox 1988; McQuarrie and Mick 1996; Peracchio and Meyers-Levy 1994) but has not established its attention effects. In addition, such research has used a multiplicity of definitions and subjective measures of complexity (Geissler, Zinkhan, and Watson 2006; Macklin, Bruvold, and Shea 1985; Morrison and Dainoff 1972; Oliva et al. 2005), which hampers generalization. The growing research stream on attention to advertising (Fox et al. 1998; Janiszewski 1998; Lohse 1997; Pieters and Wedel 2004) has not yet addressed effects of visual complexity. The current study attempts to bridge this gap.

We posit that there are two distinct types of visual complexity in advertising; we propose quantitative measures to assess each; and we examine how these predict attention, attitude toward the ad, and comprehensibility. Prior research has found that advertising effectiveness critically depends on the match between the processing resources available to the consumer and those demanded by advertising (Anand and Sternthal 1988; Peracchio and Meyers-Levy 2005). Thus, it is important to gauge the resource demands of advertising, and our proposed measures of visual complexity accomplish this. Across 249 tested magazine advertisements, we find that an advertisement's feature complexity has a negative effect on brand attention and attitude toward the ad, but an advertisement's design complexity has

[1]See http://www.marketingdirsvc.com/MDS/Get_Attention.html (last accessed May 21, 2010).

[2]See http://www.yellowpageaddesign.com/Yellow-Page-Ad-Design-tip-6.html (last accessed February 2010).

[3]See http://www.montparnas.com/articles/forget-minimalist-web-design-cluttered-pages-aren%E2%80%99t-that-bad/ (last accessed February 2010).

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a positive effect on pictorial attention, ad attention as a whole, and attitude toward the ad. Thus, rather than visual complexity having either a positive or a negative effect, we find that design complexity helps advertising attention and likability and that feature complexity hurts it. Moreover, we find that both types of visual complexity do not reduce the comprehensibility of the advertisement. These findings are important because design complexity is easily controlled by advertisers, and both visual complexity types can be readily assessed with our measures. This research contributes to a theory of complexity effects in advertising and offers guidelines for managing visual complexity to raise the stopping power of advertising.

Visual Complexity of Advertising

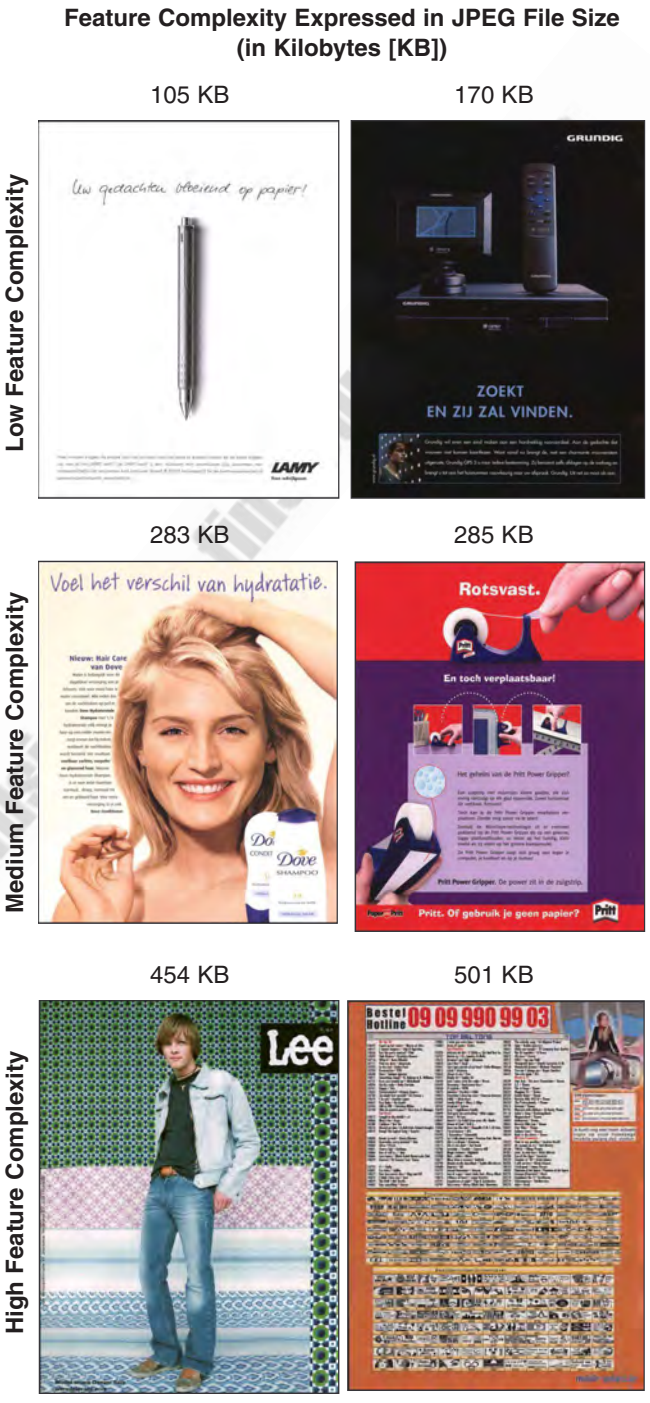
Visual complexity theory (Attneave 1954; Donderi 2006) developed from the idea that most images contain redundancy and that images are more complex to the extent that they contain less redundancy. Thus, complexity is a visual characteristic of the ad image, and it is different from the comprehensibility of the ad message, with which it is sometimes confused. To date, researchers still lack a clear understanding of how visual complexity can be measured and controlled in advertising, how it differs from an advertisement's comprehensibility, and what its implications are for ad performance. We distinguish feature and design complexity of advertising, propose quantitative measures for each, and establish their influence on attention and attitude toward the ad. In addition, we differentiate these two visual complexity types from the difficulty of identifying the brand in the advertisement as a prime visual component of an advertisement's comprehensibility.

Feature Complexity

Advertisements that contain more detail and variation in their basic visual features, color, luminance, and edges are more complex. In a computer image of an advertisement, this type of "raw" or unstructured complexity is reflected in variation at the level of individual pixels. Researchers have examined this in computer and vision science under the general labels of "visual complexity" (Donderi 2006; Huhmann 2003) or "visual clutter" (Rosenholz, Li, and Nakano 2007). Because it resides in the basic visual features of the ad image, we label it "feature complexity." The top left advertisement in Figure 1 depicting a black pen against a uniform white background is visually simpler than the middle-left advertisement, which depicts a full-color woman's face with several white and blue packshots of shampoo, because the latter has a more detailed pattern of color, luminance, and edges.

The more detail and variation there is in the three basic visual features across an image, the more computer memory is needed to store the image; in turn, this provides a convenient measure of feature complexity. The advertisements in Figure 1 are from the empirical application and measure 640 × 845 pixels. To code them with 16.7 million possible colors (24 bits) in raw form would require 1622 kilobytes for each. Image compression techniques (Shapiro and Stockman 2001) reduce the amount of computer memory needed relative to the original image by stripping an image of its redundancies. The JPEG algorithm is a standard for image compression (Wallace 1991). We use JPEG file size as the measure of feature complexity. The JPEG algorithm compresses the simple pen advertisement in the top left of Figure 1 to 105 kilobytes (15:1 compression) and the complex retail advertisement in the bottom-right corner to 501 kilobytes (over 3:1 compression). Feature complexity evokes low-level visual processes in the primary visual

FIGURE 1
Feature Complexity of Advertising: Clutter of Visual Features



cortex (Palmer 1999), and previous research has shown its influence on perception and behavior (Donderi and McFadden 2005; Rosenholz, Li, and Nakano 2007; Székely and Bates 2000).

Design Complexity

Alternatively, advertisements with more elaborate designs in terms of the shapes, objects, and patterns they contain are also more complex. Whereas feature complexity taps the unstructured variation in the visual features of image pixels, design complexity taps the structured variation in terms of specific shapes, objects, and their arrangements in the advertisement. Researchers have previously examined this under the general label of "complexity" or "structural complexity" (Arnheim 1954; Berlyne 1958; Cox and Cox 1988). Because it resides in the advertisement's creative design, we call it "design complexity." Decisions about design complexity are fundamental in ad development and under direct control of advertisers and ad agencies.

Various principles of design complexity have been independently proposed (Arnheim 1954; Donderi 2006; Palmer 1999; Wertheimer 1923). For example, Attneave (1954) proposed that asymmetry in the shape of objects increases complexity. Wertheimer (1923) suggested that dissimilarity between objects in shape, color, or size increases complexity. Berlyne (1958) proposed that the number, amount of detail, and irregularities of elements and the irregularity of their arrangement in the image increase complexity. We integrate and build on these ideas by identifying six general principles of design complexity. Figure 2 presents them with examples from the empirical application.

1. *Quantity of objects*: Design complexity is higher when the advertisement contains more rather than fewer objects (Kosslyn 1975; Palmer 1999). In Figure 2, the left (simple) advertisement for a pen contains a single product and two text blocks, while the right (complex) advertisement for cutlery contains multiple products and text blocks.
2. *Irregularity of objects*: Design complexity is greater when the objects in the advertisement are irregularly rather than regularly shaped. Regularly shaped objects contain symmetry along one or more axes, a gestalt principle that simplifies object and pattern perception (Berlyne 1958; Palmer 1999). In Figure 2, the left (simple) advertisement contains regularly shaped cans of vegetables, while the right (complex) advertisement contains an irregularly shaped object: a person with a bow and arrow.
3. *Dissimilarity of objects*: Design complexity is greater when the objects in the advertisement are dissimilar rather than similar in shapes, textures, orientations, and/or colors. Similarity is a gestalt principle that simplifies object and pattern perception (Wertheimer 1923). In Figure 2, the left (simple) advertisement shows six similarly shaped caps of an alcoholic beverage bottle, while the right (complex) advertisement pictures differently shaped packages and products for deep-frying and the fries.
4. *Detail of objects*: Design complexity is greater when the objects in the advertisement have more rather than less detail in terms of fine edges, intricate textures, or color variations (Berlyne 1958). This principle is similar to feature complexity, but it is assessed at the level of objects, not the ad image as a whole. In Figure 2, the left (simple) furniture advertisement portrays a single outline of a plastic box, while the right (complex) clothing advertisement portrays a model wearing an intricately patterned blouse.
5. *Asymmetry of object arrangement*: Design complexity is greater when the objects in the advertisement form asymmetric rather than symmetric arrangements. This reflects the gestalt principle of symmetry at the level of the ad layout rather than at the level of individual objects (Wertheimer 1923). The left (simple) advertisement in Figure 2 is symmetric and shows a car approaching a T-section toward the horizon, while the right (complex) advertisement is asymmetric and pictures a dominant bottle of a dairy drink left of the vertical median.
6. *Irregularity of object arrangement*; Design complexity is greater when the objects in the advertisement form an irregular rather than a regular pattern, with the extreme being a random distribution of objects across space (Berlyne 1958; Donderi 2006). The left (simple) advertisement in Figure 2 contains two dominant rows of shoes that are regularly arranged, while the right (complex) furniture advertisement contains various differently shaped products in an irregular arrangement.

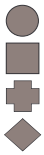
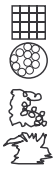
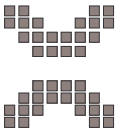
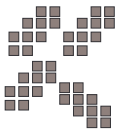
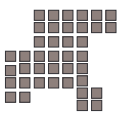
Because each of the six principles independently raises complexity, we can obtain an overall index of design complexity by summing them (Diamantopoulos and Winklhofer 2001). Design complexity evokes midlevel visual processes of object and pattern perception (Palmer 1999), and specific aspects of it have previously been shown to influence perception and behavior (Berlyne 1958, 1974; Cox and Cox 1988; Donderi 2006; Peracchio and Meyers-Levy 1994, 2005).

Brand Identification Difficulty

The complexity and comprehensibility of advertisements are distinct constructs. That is, the image of an advertisement can be visually simple or complex, independent of whether the message of the advertisement is easy or complicated to understand. Not only has some prior research treated complexity and comprehensibility as interchangeable constructs (Cox and Cox 1988; Oliva et al. 2005), but measures of the constructs may also be naturally correlated in a particular set of advertisements. Thus, it is relevant to distinguish the complexity and comprehensibility of advertisements and control for the latter when testing the effects of the former. We concentrate on a visual determinant of ad comprehensibility, namely, the ease or difficulty of identifying the advertised brand. That is, to comprehend an advertisement, consumers need to identify the advertised brand and accurately process the message about it. The comprehension literature has examined accurate message processing (Jacoby and Hoyer 1989; Mick 1992) but not the ease or difficulty with which consumers can identify the advertised brand (i.e., brand identifiability). Brand identifiability reflects a midlevel visual process (Palmer 1999) because the brand—as the target object—needs to be found in the advertisement to process information about it, and the latter is a high-level cognitive process.

Brand identifiability is under the advertiser's control and is a key consideration in ad design (Book and Schick 1997; Nelson 1985; Pieters and Wedel 2004). As a case in point, Moriarty (1986, p. 291) argues that "the most important thing to remember in national advertising is to focus on

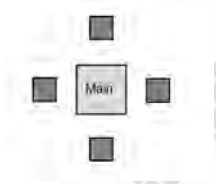
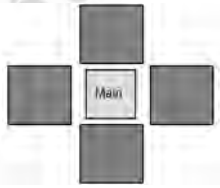
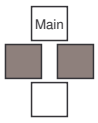
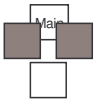
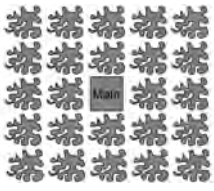
FIGURE 2
Design Complexity in Advertising: Six Principles

Principle	Design Complexity		Sample Advertisement	
	Low	High	Simple	Complex
Quantity of objects: number of objects is small or large (many = complex)				
Irregularity of objects: shape of objects is regular or irregular from symmetry along one or more axes (irregular = complex)				
Dissimilarity of objects: shape, color, texture, orientation of objects are similar or dissimilar (dissimilar = complex)				
Detail of objects: objects have less or more visual detail from color, edges, texture (detail = complex)				
Asymmetry of object arrangement: spatial arrangement of objects is symmetric or asymmetric (asymmetric = complex)				
Irregularity of object arrangement: spatial arrangement of objects is regular or irregular (irregular = complex)				

identification of the brand." Figure 3 presents four general principles of ad design that reduce brand identifiability, independent of the ad space devoted to the brand:

1. *Low brand contrast*: Brands are more difficult to identify when their contrast with other objects and the background in the advertisement is low rather than high because of blurred contours or small luminance differences (Palmer 1999; Rubin [1921] 2000). In Figure 3, the left advertisement for frozen vegetables has sharp contours and high figure–ground contrast, which makes the brand easy to identify, while the right advertisement has more soft-focus contours and uniform luminance.
2. *Small relative brand size*: Independent of their absolute size in the advertisement, branded products are more difficult to identify when their size relative to other objects or to the background is small (Kosslyn 1975). Large competing objects draw attention and hamper easy identification of the brand because it appears to be smaller. The left advertisement in Figure 3 contains a life-size picture of only a watch, which stands out and makes the brand easier to identify, while the left advertisement contains a small picture of a car against a desert background and open sky.
3. *Brand masking*: Brands are more difficult to identify when they are masked rather than isolated and complete (Rosenholz, Li, and Nakano 2007). Masking may occur as a result of occlusion by other objects, overlaps, cutouts, and cropping at the borders (Arnheim 1954; Peracchio and Meyers-Levy 1994). Masked objects are more likely perceived as part of the background, which complicates their identification. The left advertisement in Figure 3 contains a complete packshot of a box of cigarettes, while the right advertisement contains a pictorial of a "cropped" man in the target underwear, which is partly occluded by the woman's leg. This makes brand identification difficult.

FIGURE 3
Difficulty of Brand Identification in Advertising: Four Principles

	Difficulty of Brand Identification		Sample Advertisement	
Principle	**Low**	**High**	**Easy**	**Difficult**
Low brand contrast: brand stands out or blends in from blurring or low luminance contrast (low = difficult)				
Small relative brand size: brand is large or small relative to other objects (small = difficult)				
Brand masking: brand is complete or incomplete from masking, occlusion, cropping, cutouts (masked = difficult)				
Heterogeneity of brand background: brand background is homogeneous or heterogeneous (heterogeneous = difficult)				

4. *Heterogeneity of brand background*: Brands are more difficult to identify when the background is dense and heterogeneous rather than sparse and homogeneous (Duncan and Humphreys 1988; Pieters, Wedel, and Zhang 2007). The left advertisement in Figure 3 shows a person wearing the advertised brand of jeans against a homogeneous background, which makes the brand easier to identify, while the right advertisement shows a heterogeneously populated cartoon scene with various shapes and colors, which makes the advertised brand of sportswear more difficult to discern.

We obtain an overall index of brand identifiability by summing across the four principles (Diamantopoulos and Winklhofer 2001). Because each principle reduces brand identifiability, we reverse-score the final index so that higher scores indicate better brand identifiability. To date, marketing research on the effects of brand identifiability principles has been scarce.

Hypotheses

We test the influence of visual complexity and brand identifiability on attention to the advertisement as a whole, to the brand, and to the pictorial and text in the advertisement, as well as on ad comprehensibility and attitude toward the ad. We predict that feature and design complexity have distinct effects that differ from those of brand identifiability. Specifically, we expect the following:

H_1: Feature complexity has a negative effect on (a) attention to the brand in the advertisement, (b) attention to the advertisement as a whole, and (c) attitude toward the ad.

Images high in feature complexity are visually cluttered, which hinders people in locating specific objects in them (Donderi and McFadden 2005; Rosenholz, Li, and Nakano 2007). Advertisements high in feature complexity divert people from carefully looking at the brand, which reduces attention to the advertisement as a whole (Pieters, Wedel, and Zhang 2007). Because the brand receives less attention, people cannot easily determine what the advertisement is for and thus like it less. In general, the processing load caused by high levels of visual clutter should be liked less because consumers' motivation and ability to process information are low under normal ad-viewing conditions (Anand and Sternthal 1988). Because feature complexity evokes low-level visual processes, we do not hypothesize an effect on ad comprehensibility. With respect to design complexity, we predict the following:

H_2: Design complexity has a positive effect on (a) attention to the pictorial in the advertisement, (b) attention to the advertisement as a whole, and (c) attitude toward the ad.

Whereas simple designs activate habitual object and pattern perception processes, more complex designs are expected to be more engaging and likable (Palmer 1999). Berlyne (1958, 1974) calls this the collative or "glueing" property of images, which has aesthetic qualities. Because the design complexity of advertisements mostly resides in the pictorial rather than in the brand or text, people should pay more attention to the pictorial, which will raise attention to the advertisement as a whole. Because the complex pictorial is more engaging, people are also expected to like the advertisement more.

Prior advertising research has reported inverted U-shaped effects, such that attention and attitude were highest at intermediate levels of complexity and lower at the extremes (e.g., Geissler, Zinkhan, and Watson 2006; Morrison and Dainoff 1972). The idea is that deviations from some optimal level of complexity are either insufficiently or overly challenging, which hurts attention and attitudes. However, some of this research has used subjective measures of complexity that include items such as "simple–complicated." The finding that attention and attitude are lowest at the extremes of such a complexity spectrum is difficult to interpret because the terms "simple" and "complicated" are both evaluatively negative and, furthermore, complexity need not be "complicated." In light of the previous findings, we explore possible inverted U-shaped effects of feature and design complexity, but we do not hypothesize that such effects are present with our new measures. In addition, because design complexity evokes midlevel perceptual processes and does not raise visual clutter, we do not hypothesize that it influences ad comprehensibility. With respect to identifiability of the brand, we predict the following:

H_3: Difficulty of identifying the brand has a negative effect on (a) attention to the brand in the advertisement, (b) attention to the advertisement as a whole, and (c) ad comprehensibility.

Rather than stimulating increased attention, which might occur under high levels of motivation or under forced exposures, it is likely that the difficulty of identifying the brand reduces attention to the brand and, thus, to the advertisement as a whole under the low levels of motivation during self-paced ad exposure. Difficulty of identifying the advertised brand hinders information acquisition and processing of the brand. This has a negative effect on ad comprehensibility. We do not hypothesize an effect of brand identification difficulty on attitude toward the ad, in view of Peracchio and Meyers-Levy's (1994) findings that attitudinal effects of cropping and similar principles were absent under low motivation conditions.

Joint support for these hypotheses would reveal that rather than visual complexity being either good or bad, feature complexity hurts and design complexity helps attention to and attitude toward the ad. It would further show that the difficulty of identifying the brand, a related but different visual property of advertisements, hurts ad attention and comprehensibility.

Data and Analyses

Data

Data are available for a representative, random sample of 249 full-page advertisements appearing in general-interest consumer magazines (Figures 1 and 2 show examples of the advertisements). The information for each advertisement consists of (1) feature complexity (JPEG file size), design complexity, and brand identifiability (coded by a panel of three trained judges); (2) attention to the brand, pictorial, text, and advertisement as a whole (average gaze durations

across approximately 100 regular consumers for each advertisement); (3) attitude toward the ad and ad comprehensibility (based on a panel of 12 trained judges); (4) control variables, including sizes of brand, pictorial and text in the advertisements (obtained with graphical software), and brand and ad familiarity (scored by 10 judges); and (5) experienced complexity of ad design and difficulty of identifying the brand (based on two separate samples of approximately 100 participants each). We use the two variables in the fifth category to validate the proposed measures of visual complexity and brand identifiability. These variables are included as columns in two separate data sets with advertisements times participants as rows. All other variables are included as columns in the final data set with the advertisements as rows. Table 1 provides summary statistics for this final data set.

The market research company Verify International provided attention data collected with infrared eye-tracking (Wedel and Pieters 2008) on 249 advertisements from 35 tests conducted in 2002, each with more than 100 participants representing the general population over 18 years of age. Thus, the attention data for the current study are based on more than 3500 participants. Participants were instructed as follows: "Page through several magazines that are presented on the monitor. You can do this at your own pace, as you would do at home or in a waiting room." Next, the advertisements were shown with the editorial counterpage from the magazine in which they appeared, in the sequence in which they appeared (four magazines per test). Instructions and stimuli were presented on 21-inch LCD monitors in full-color bitmaps with a 1280 × 1024 maximum pixel resolution. Participants continued to a next page by touching the lower-right corner of the touch-sensitive screen, as when paging. The task, stimuli, and context reflect ordinary ad exposure situations. The company provided the average gaze duration for each advertisement as a whole and for the brand, the pictorial, and the text in the advertisement. Before the analyses, gaze durations were log-transformed.

Bitmaps of 640 × 845 pixels of all 249 advertisements were available in JPEG format. The log-JPEG file size in kilobytes (Donderi and McFadden 2005; Rosenholz, Li, and Nakano 2007) of the ad images is our measure of feature complexity of advertising. Three trained judges manually coded design complexity and brand identifiability in terms of the presence (1) or absence (0) of each of the six design complexity principles (Figure 2) in the 249 advertisements. The modal response across coders (0/1) for each principle was assigned to each advertisement ($\alpha = .76$). The measure of ad design complexity was calculated as the average of the six principles for each advertisement, to arrive at a proportion between 0 and 1. Brand identifiability was similarly coded on the basis of its four principles (Figure 3), and the measure was calculated as the average of the four principles for each advertisement, to arrive at a proportion between 0 and 1. This score was reversed so that higher scores indicate better brand identifiability.

We obtained measures of ad comprehensibility and attitude from a separate panel of 12 trained judges (6 male and 6 female research assistants). Items were rated on five-point response scales ranging from "completely disagree" (1) to "completely agree" (5). We assessed ad comprehensibility with three items: "Overall, this ad is …" (1) "difficult to comprehend," (2) "complicated," and (3) "unclear." Scores were reversed so that higher values express increased ad comprehensibility. We assessed attitude toward the ad with four items: "Overall, this ad is …" (1) "attractive," (2) "useful," (3) "entertaining," and (4) "good." We computed average scores across judges and items ($\alpha = .84$ and .76, respectively).

TABLE 1
Summary Statistics for Advertising Data

Measures	M	SD	Minimum	Maximum
A. Objective Measures				
1. Feature complexity (JPEG file size in kilobytes)	284.12	63.79	105	501
2. Design complexity (proportion: 0 = low, 1 = high)	.33	.20	.00	1.00
3. Brand identifiability (proportion: 0 = low, 1 = high)	.79	.19	.25	1.00
B. Ratings				
1. Ad comprehensibility (1 = low, 5 = high)	4.01	.55	2.22	5.00
2. Attitude toward the ad (1 = negative, 5 = positive)	3.16	.43	2.04	4.25
C. Attention				
1. Brand (seconds)	.47	.33	.01	1.83
2. Pictorial (seconds)	1.04	.44	.02	2.96
3. Text (seconds)	1.06	.59	.01	4.42
4. Advertisement as a whole (seconds)	2.12	.66	.71	6.54
D. Control Variables				
1. Brand space (proportion of total ad size)	.10	.06	.01	.39
2. Pictorial space (proportion of total ad size)	.62	.25	.01	1.00
3. Text space (proportion of total ad size)	.28	.16	.01	.75
4. Brand familiarity (0 = unknown, 1 = known)	.78	.41	.00	1.00
5. Ad familiarity (1 = low, 5 = high)	2.17	.82	.00	4.67

Notes: Based on N = 249 advertisements. Attention duration for the advertisement as a whole is not the exact sum of attention to the separate ad elements, because attention to overlapping ad elements is assigned to both. Raw JPEG file size is shown; log-file size is used in the analyses.

We obtained information about control variables as follows: We determined the brand, pictorial, and text space (as a proportion of total ad space) using standard graphical software. Brand familiarity (0 = low, and 1 = high) and ad familiarity ("This specific ad for the brand is familiar to me," where 1 = "not at all" and 5 = "completely") were scored by a separate panel of ten judges (5 male and 5 female judges; both $\alpha = .75$).

Validation

To validate the measures of visual complexity and brand identifiability, the 249 advertisements were rated by two samples of 104 (M_{age} = 21.7, 63% male) and 102 (M_{age} = 21.6, 44% male) undergraduate students. Advertisements were presented in random order on computer monitors, and participants responded by clicking on the appropriate response. For each advertisement, the first sample responded to the item "This ad design is ..." on a five-point scale ranging from "very simple" (1) to "very complex" (5). The average was 3.00 (SD = 1.00, across 104 participants and 249 advertisements). The second sample indicated the following for each advertisement: "How easy or difficult is it to detect the advertised brand?" on a five-point scale ranging from "very easy" (1) to "very difficult" (5). The average was 2.71 (SD = 1.31, across 102 participants and 249 advertisements). In this second sample, we also recorded response latencies as the time between start of an ad exposure and response to the question for each advertisement and participant (mean latency 2.29 seconds, SD = 2.13).

We analyzed the validation data using multilevel regression analyses with full heterogeneity across participants in all coefficients. We estimated models with experienced complexity (104 participants) and experienced difficulty of brand identification (102 participants) as the dependent variables ($y_{i,j}$) and with measures of feature and design complexity and brand identifiability as the independent variables ($x_{i,j}$). The sizes of the three ad elements and brand and ad familiarity were control variables. We estimated models for individuals i = 1, ..., N; advertisements j = 1, ..., J; and p = 1, ..., P independent variables:

$$(1)\qquad \begin{aligned} y_{i,j} &= x'_{i,j}\beta_i + \varepsilon_{i,j} \\ \beta_{i,p} &\sim N\left(\bar{\beta}_p,\ \sigma^2_{\beta,p}\right), \end{aligned}$$

where the parameter vector $\beta_i = (\beta_{i,p})$ is individual specific and $\varepsilon_{i,j} \sim N(0, \sigma_y^2)$. We estimated models with the Gibbs sampler (Gill 2008), with standard noninformative prior distributions, using 15,000 draws with a burn-in of 5000. We present the posterior mean and posterior standard deviation of the posterior distributions of the parameters.

The results (see Table 2) support the validity of the proposed measures. Higher levels of feature complexity (M = .547, SD = .036) and design complexity (M = .163, SD = .045) raised experienced complexity of the ad design, after we controlled for all other effects. Brand identifiability had no effect (M = .095, SD = .076). In addition, lower levels of brand identifiability increased the experienced difficulty of finding the advertised brand (M = –.558, SD = .047). Feature (M = –.064, SD = .037) and design (M = .069, SD = .037) complexity had no effect.

TABLE 2
Determinants of Experienced Complexity and Brand Identification Difficulty

Predictors	Experienced Complexity of Ad Design	Experienced Difficulty of Brand Identification
Constant	–.313 (.184)	**3.325 (.204)**
Brand space (0, ..., 1)	.029 (.139)	**–2.140 (.262)**
Pictorial space (0, ..., 1)	.026 (.056)	**–.387 (.053)**
Text space (0, ..., 1)	**.959 (.160)**	**1.792 (.155)**
Brand familiarity (0, 1)	–.025 (.017)	**–.155 (.023)**
Ad familiarity (1, ..., 5)	**–.065 (.009)**	**–.117 (.017)**
Feature complexity (log-JPEG)	**.547 (.036)**	–.064 (.037)
Design complexity (0, ..., 1)	**.163 (.045)**	.069 (.037)
Brand identifiability (0, ..., 1)	.095 (.076)	**–.558 (.047)**
Heterogeneity: constant (u)	.302 (.056)	.970 (.154)
Heterogeneity: residual (e)	1.007 (.009)	1.017 (.009)
Ad level R^2	13.9%	20.7%

Notes: N advertisements = 249. N participants = 104 for "experienced complexity of ad design," and N participants = 102 for "experienced difficulty of brand identification." The standard deviations of the parameter estimates are in parentheses. Bold estimates are significant at 5%.

An additional regression analysis (not shown) revealed that, as we expected, higher levels of brand identifiability led to a faster response to the question of how easy or difficult the brand can be identified (log-latency) (M = –.112, SD = .015), after we controlled for all other effects. Brand familiarity (M = –.049, SD = .008) and feature complexity (M = –.064, SD = .016) led to faster responses, and larger surface sizes of the pictorial (M = .105, SD = .020) and text (M = .234, SD = .041) led to slower responses, with no other effects significant. This supports the validity of the visual complexity and brand identifiability measures.

Analyses

To establish the effects of visual complexity and brand identifability on attention, we use a multivariate multilevel regression model with a random intercept to control for differences between the 35 tests (there is no reason to expect other parameters to be heterogeneous across the 35 tests). We specify the model for the (1 × Q) vector of gaze durations, $Y_{j,t}$, for advertisements j = 1, ..., J and tests t = 1, ..., T, as follows:

$$(2)\qquad \begin{aligned} \log\left(Y_{j,t}\right) &= \beta_{0,t} + x'_{j,t}B + E_{j,t} \\ \beta_{0,t} &\sim N\left(\bar{\beta}_0,\ \Sigma_\beta\right) \end{aligned},$$

where $B = (\beta_{p,q})$ is the (P × Q) parameter matrix and $E_{j,t} \sim N(0, \Sigma_y)$ is the (1 × Q)-residual vector. We estimated additional multivariate regression models to examine the influence of predictors on ad comprehensibility and attitude

toward the ad. We estimated all models with the Gibbs sampler (Gill 2008) with noninformative conjugate prior distributions. We use a burn-in of 5000 and present the posterior mean and posterior standard deviation of the posterior distributions of the estimates across 15,000 target draws.

Results

Feature complexity (JPEG file size) ranged from a minimum of 105 kilobytes for the pen advertisement at the top left of Figure 1 to a maximum of 501 kilobytes for the retail advertisement at the bottom right of Figure 1. The shampoo and stationary advertisements in the middle of Figure 1 were closest to the average of 284 kilobytes. These JPEG file sizes are based on images of 640 × 845 pixels; measures for images with other dimensions may differ. On average, design complexity was 33%, ranging from a minimum of 0%, for example, for the pen advertisement at the top left of Figure 2 to a maximum of 100% for the furniture advertisement at the bottom right of Figure 2. Finally, on average, brand identifiability was 79%, ranging from a minimum of 25% for the sportswear advertisement at the bottom right of Figure 3 to a maximum of 100% for the frozen vegetables advertisement at the top left of Figure 3.

Correlations between the measures of visual complexity and brand identifiability are modest. This indicates that they largely tap different constructs, as was our intention. Feature complexity shares approximately 16% of variance with design complexity (r = .390, $p < .05$) and 5% with brand identifiability (r = –.232, $p < .05$), and design complexity and brand identifiability share 4% (r = –.212, $p < .05$).

Effects on Attention to Advertising

In support of H_{1a}, feature complexity reduces attention to the brand (M = –.473, SD = .205), as we show in Table 3. This reflects the detrimental effects of increased visual clutter in the ad image. The decrement in brand attention is too small to translate into an overall ad attention decrement, which is counter to H_{1b}.

In support of H_{2a}, design complexity increases attention to the pictorial (M = .682, SD = .161). This reflects the collative properties of this type of complexity. In support of H_{2b}, the net effect of design complexity on attention to the advertisement as a whole is positive as well (M = .260, SD = .095).

Brand identifiability does not significantly influence brand and ad attention, which disconfirms H_{3a} and H_{3b}. As in practice, attention to the brand in the advertisement was limited to begin with—an average of 470 milliseconds, or approximately two eye fixations. Thus, reduced brand identifiability may not be able to decrease brand attention further because of a floor effect. Yet the validation data point to another possibility. They showed that reduced brand identifiability led participants to experience greater difficulty in identifying the brand, but it also led to longer response latencies in responding to this question. Taken together, the validation and attention data indicate that reduced brand identifiability increased the time before participants found the brand but did not result in reduced attention after they found it. This finding makes the observed detrimental effect of feature complexity on brand attention even more telling.

To explore potential nonlinear and interaction effects, we added the products of feature and design complexity and their second-order polynomials (after mean-centering) to the regression models for brand, pictorial, and text attention and for the advertisement as a whole. None of the parameter estimates were substantively meaningful and significant. Thus, we cannot reject the hypothesis that across the large set of regular advertisements, the effects of visual complexity on attention were linear and additive.

Effect on Ad Comprehensibility and Attitude Toward the Ad

Table 4 shows that increased levels of feature complexity hurt attitude toward the ad (M = –.318, SD = .136), confirming H_{1c}. This reveals the importance of preventing visual clutter in advertisements. In contrast, increased levels of design complexity help attitude toward the ad (M = .276, SD = .131), confirming H_{2c}. Design complexity improves

TABLE 3
Complexity Effects on Attention to Advertising

	Attention			
Predictors	**Brand**	**Pictorial**	**Text**	**Overall Ad Attention**
Constant	1.044 (.996)	**–2.290 (.807)**	–.323 (1.116)	.170 (.482)
Brand space (0, ..., 1)	**8.087 (.626)**	**1.455 (.509)**	–.174 (.702)	.344 (.300)
Pictorial space (0, ..., 1)	.140 (.231)	**1.334 (.188)**	–.096 (.259)	–.103 (.112)
Text space (0, ..., 1)	–.175 (.423)	–.227 (.342)	2.762 (.474)	.279 (.202)
Brand familiarity (0, 1)	*–.189 (.096)*	.025 (.078)	.103 (.108)	–.004 (.046)
Ad familiarity (1, ..., 5)	–.071 (.052)	–.018 (.043)	**–.237 (.059)**	**–.082 (.025)**
Feature complexity (log-JPEG)	**–.473 (.205)**	.191 (.166)	–.008 (.229)	.105 (.099)
Design complexity (0, ..., 1)	.154 (.197)	**.682 (.161)**	.081 (.222)	**.260 (.095)**
Brand identifiability (0, ..., 1)	–.010 (.050)	–.019 (.041)	.091 (.057)	.025 (.097)
Heterogeneity: constant (u)	.001 (.009)	.015 (.010)	.011 (.015)	.005 (.004)
Heterogeneity: residual (e)	.308 (.029)	.195 (.019)	.380 (.036)	.069 (.007)
Ad level R^2	42.4%	42.0%	41.4%	19.8%

Notes: N = 249. The standard deviations of the parameter estimates are in parentheses. Bold estimates are significant at 5%, and italicized estimates are significant at 10%.

TABLE 4
Complexity Effects on Ad Comprehensibility and Attitude

Predictors	Ad Comprehensibility	Attitude Toward the Ad
Constant	**4.353 (.902)**	**4.671 (.661)**
Brand space (0, ..., 1)	**1.604 (.570)**	–.453 (.418)
Pictorial space (0, ..., 1)	.345 (.209)	**.410 (.155)**
Text space (0, ..., 1)	.177 (.384)	–.535 (.284)
Brand familiarity (0, 1)	–.004 (.087)	.118 (.065)
Ad familiarity (1, ..., 5)	**.183 (.047)**	.018 (.035)
Feature complexity (log-JPEG)	–.206 (.185)	**–.318 (.136)**
Design complexity (0, ..., 1)	**.400 (.178)**	**.276 (.131)**
Brand identifiability (0, ..., 1)	**.643 (.181)**	.067 (.134)
Heterogeneity: residual (e)	.252 (.023)	.137 (.013)
Covariance between residuals	.068 (.013)	—
Ad level R^2	17.7%	26.3%

Notes: N = 249. The standard deviations of the parameter estimates are in parentheses. Bold estimates are significant at 5%.

ad comprehensibility as well (M = .400, SD = .178), which we did not hypothesize. Confirming H_{3c}, higher brand identifiability improves ad comprehensibility (M = .643, SD = .181). The reduced time to find the brand when brand identifiability is high (as revealed by the validation data) may lead participants to experience the advertisement as more comprehensible. This positive effect of brand identifiability is independent of the already positive effect of ad familiarity (M = .183, SD = .047) and increases in the sheer size of the brand (M = 1.604, SD = .570) on ad comprehensibility. This shows that independent of the sheer size of the brand in the advertisement, creative techniques that increase brand–background contrast in the advertisement help ad comprehensibility.

Quadratic effects of feature complexity, design complexity, and brand identifiability were not significant, so we cannot reject the hypotheses that their effects on attitude toward the ad and comprehensibility are linear. Furthermore, we conducted a Bayesian mediation analysis (Zhang, Wedel, and Pieters 2009). A challenge in classic mediation analyses is to obtain standard errors of the mediated effect and of the total effect of the independent variable and, thus, valid significance tests of these effects. An advantage of the Bayesian estimation of mediation models is that it allows computation of the standard error of these effects in a straightforward manner, even for small samples. The analysis reveals that attention to the pictorial mediates the effects of design complexity on ad comprehensibility ($M_{\text{pictorial attention}}$ = .155, SD = .074; $M_{\text{design complexity}}$ = .292, SD = .185) and attitude toward the ad ($M_{\text{pictorial attention}}$ = .150, SD = .053; $M_{\text{design complexity}}$ = .167, SD = .132). Attention did not mediate the effect of feature complexity on attitude toward the ad (there was no effect on ad comprehensibility).

Conclusion and Implications

This research provides an answer to the question whether visual complexity helps or hurts advertising performance. Rather than higher levels of visual complexity being either harmful or helpful, we identified two distinct types of visual complexity with divergent effects on advertising performance. Feature complexity is the density of visual detail in the advertisement in terms of color, luminance, and edges. It hurts brand attention and attitude toward the ad. Design complexity is the intricacy of the creative design of the advertisement in terms of its shapes, objects, and organization. It helps attention to the pictorial and to the advertisement as a whole, ad comprehensibility, and attitude toward the ad. These findings are important because design complexity is under direct control of advertising creatives, agencies, and advertisers. In addition, we proposed and found that visual complexity is distinct from brand identifiability (i.e., the difficulty or ease of identifying the advertised brand). Increased difficulty of identifying the advertised brand harmed ad comprehensibility. Jointly, this reveals that complex advertisements need not be complicated and that the question whether visual complexity harms or helps advertising performance critically depends on where the complexity resides: the features or the design of the advertisement. Feature complexity harms and design complexity helps ad performance.

We proposed measures to assess feature complexity, design complexity, and brand identifiability and established their validity. Feature complexity is captured by the file size of the JPEG-compressed visual image of the advertisement. The measure is broadly available and reflects the amount of visual clutter in the image. We captured design complexity and brand identifability through manually coded measures that can be readily implemented using the proposed methodology.

Implications for Advertising Planning

This research is the first to document the harmful effects of feature complexity in advertisements. The positive attention effect of this type of visual clutter has long been a subject of speculation, but instead of slowing "down the reader, making things more difficult to take in" (Nelson 1985, p. 115), feature complexity actually reduced attention to the brand and attitude toward the ad. Stuffing the advertising image with much visual detail is harmful and prevents people from paying attention to the brand in the advertisement. At first, the finding that feature complexity reduced attention to the brand seems to conflict with Donderi and McFadden's (2005) finding that visual clutter increased the time to find a target object in images of graphs and charts. In their study, people were explicitly instructed to search for a target and to stop only when they accomplished this objective. In practice, and as reflected in our data, processing resources are limited, and attention to the brand is low and drops further when advertisements are cluttered. This occurs because people do not look at the brand at all if they cannot find it fast enough or look at it only briefly when they do find it because featural complexity distracts or prevents them from paying attention longer. Because attention to the advertised

brand plays a crucial role in building subsequent brand memory (Wedel and Pieters 2000), reduced brand attention can have long-term detrimental effects for brand equity. On the basis of these findings, we recommend a reduction of feature-based clutter in advertisements whenever possible.[4] This is particularly important in environments with high attention competition, such as in the *Yellow Pages*, retail, and newspaper advertising, as well as in media contexts with brief exposure durations, such as outdoor and point-of-purchase advertising.

Recently, Pracejus, Olsen, and O'Guinn (2006) observed that advertisements with much "white space" led to more positive brand attitudes. We explain their observation by showing that it may not be the amount of white space per se but rather the lack of clutter in the ad image that is vital because advertisements with more white space tend to have lower feature complexity, and this improves attitudes. Note that one of the least cluttered advertisements in our sample was largely black (the top-right advertisement in Figure 1), so "black space" may have a similar effect. Increasing the amount of white space is only one way to reduce visual clutter. Reducing visual clutter can be achieved in various ways and can be checked easily according to the file size of the images of the ad prototypes.

The design complexity effects we found support Berlyne's (1958, 1974) ideas about the collative ("glueing") effects of visual complexity on attention and liking. He argues that visual complexity has aesthetic qualities and is engaging, and he finds that people look longer at more complex abstract line drawings. The findings in the current study show that across many advertised products and brands, design complexity helps attention to the pictorial in advertisements and, thus, the advertisement as a whole, independent of feature-based visual clutter, size of the pictorial, brand identifiability, and ad and brand familiarity. The attentional benefit of design complexity is specific to the ad element in which it mostly resides, namely, the pictorial, which translates into attention to the advertisement as a whole. Design complexity also improved ad comprehensibility and attitude toward the ad. It raised the aesthetic qualities and "well-formedness" of advertisements and was, in this case literally, "in the eye of the beholder," as reflected in longer pictorial attention. Thus, the recommendation to use visually complex ad designs to stop consumers and retain attention in likable ways is warranted. This is particularly important in communication situations in which advertisements need to be visually appealing, such as in thematic magazine advertising; here, paying attention to pictorials, perceiving them as comprehensible, and having a positive attitude toward them will improve ad effectiveness.

The measure of design complexity and its six principles can be used in advertising planning and to benchmark design complexity relative to other advertisements. On average, advertisements in our sample used two of the six principles of design complexity, with 13% using none, 20% using one, 29% using two, 29% using three, and 8% using four or more. This empircal distribution of levels of complexity can be used as a benchmark in creative ad design. In the current results, each principle increased pictorial attention by a factor 1.120 and ad attention as a whole by 1.044. Attention to the pictorial was a little more than one second, and attention to the advertisement as a whole was a little more than two seconds, which is representative of exposure durations in real-life situations (Pieters and Wedel 2004). We predict that including all six design complexity principles should almost double pictorial attention to close to two seconds and increase attention to the advertisement by approximately 30%, or more than two-and-a-half seconds. In addition, it should improve ad comprehensibility and attitude toward the ad.

The measure of design complexity gives ad designers control over the creative process by offering ideas on the complexity principles to include in their advertisements and feedback about the effects of their ad concepts before any costly concept testing or pretesting on samples of consumers has taken place. This should reduce turnaround times and help further improve advertising effectiveness at a low cost. The measure may also be used, for example, to set maximum and/or minimum desirable levels of visual complexity for certain advertisements, brands, or communication contexts. The finding that feature complexity hurts ad processing and effectiveness should sensitize ad designers to increase design complexity, while keeping feature-based visual clutter at a minimum.

Advertisements with less space devoted to the brand were less comprehensible; in addition, those in which brand identification was difficult were considered less comprehensible. These findings extend prior findings on ad comprehension (Jacoby and Hoyer 1989; Mick 1992). Knowing which brand is advertised conveys vital information to consumers about the personal relevance of the advertisement and which information to expect and extract from it. The current research is the first to document the effect of brand identifiability on ad comprehension. Advertisements with brands that are difficult to identify are considered less comprehensible but not more complex. Thus, when advertisements need to be rapidly comprehensible, the recommendation to "play the brand front and center" (Moriarty 1986, p. 291) is warranted.

Future Directions

The visual complexity framework and measures are relevant for other communication stimuli and media, including Web sites and product packages, and we encourage their future application to those areas. Levels of visual complexity and difficulty of brand identification are likely to be much higher for Web sites than for magazine advertisements. Web sites commonly contain multiple messages, sometimes for different brands, each with their own design and content that, at the same time, collaborate and compete for consumers' attention. It might be expected that visual complexity effects are even more dramatic in such highly competitive contexts. The proposed measures may quantify and help optimize complexity and brand identifiability to improve communication performance.

[4]See http://www.yellowpageaddesign.com/Yellow-Page-Ad-Design-tip-6.html (last accessed February 2010).

Likewise, package designs need to communicate quickly in competitive store environments. For example, consider the following designer's experience: "So I'm at the wine section of my local grocery store and as I stood there looking at all the labels trying to scream for my attention, I realized that large, simple shapes took over. Labels that either used white space the best, or used a very identifiable image on the front seemed to jump forward. That doesn't mean that they necessarily looked upscale, or were positioned correctly for their target market, but it did make them noticeable. Sometimes, less really is more."[5] Further research could test these and similar ideas about complexity effects on package design performance using the presented complexity framework and measures. If the findings generalize to Web sites and packages, here too they should be uncluttered and complex, but not complicated, to have likable stopping power.

[5]See http://nowdesign.blogspot.com/2009/08/visual-clutter.html (last accessed February 2010).

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