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Given the number of volume judgments made by consumers, for example, deciding which package is larger and by how much, it is surprising that little research pertaining to volume perceptions has been done in marketing. In this article, the authors examine the interplay of expectations based on perceptual inputs versus experiences based on sensory input in the context of volume perceptions. Specifically, they examine biases in the perception of volume due to container shape. The height of the container emerges as a vital dimension that consumers appear to use as a simplifying visual heuristic to make a volume judgment. However, perceived consumption, contrary to perceived volume, is related inversely to height. This lowered perceived consumption is hypothesized and shown to increase actual consumption. A series of seven laboratory experiments programmatically test model predictions. Results show that perceived volume, perceived consumption, and actual consumption are related sequentially. Furthermore, the authors show that container shape affects preference, choice, and postconsumption satisfaction. The authors discuss theoretical implications for contrast effects when expectancies are disconfirmed, specifically as they relate to biases in visual information processing, and provide managerial implications of the results for package design, communication, and pricing.

Vital Dimensions in Volume Perception: Can the Eye Fool the Stomach?

Mavis,[1] a psychology doctorate, went to the Beach Bar and had to keep getting refills of red wine. She got tired of the walk and asked for a larger glass, for which she paid a higher price. She was surprised when she realized she had paid a higher price for the same volume.

[1]Examples are based on actual incidents. Names have been disguised to maintain anonymity.

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At the same pub on another day, Joe, a marketing professor, insisted that the Carlsberg pint was larger than the Fosters pint. Whereas the Fosters is served in a keg-shaped glass, the Carlsberg glass is taller and shaped like a tankard. They both contain one pint of beer.

David, a supplier of bar equipment, purchased new teacups for his wife because their old ones seemed small. After using the new teacups, David's wife complained that they were not as satisfying as their old set. David was astonished because the new cups looked bigger. It was evidently an illusion; the cups were the same volume.

On a domestic flight, Sandy decided to try a new Lychee fruit drink, packaged in a tetrapack of 200 milliliters (ml). He was surprised at how full he felt midway through drinking the juice. It had seemed such a small portion when he accepted it.

For a business class transatlantic flight, the airline changed the glasses in which it served champagne from saucers to flutes. Sheila, who was trying to cut down on alcohol, asked to get just half a glass. She was surprised at how quickly it was gone and wished she had asked for more.

In this article, we examine the effect of container shape on volume perceptions. Given that actual volume has been

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shown to affect actual consumption positively (Wansink 1996), we explore the implications of higher perceived volume on both actual and perceived consumption. The interplay among three constructs, perceived volume (volume perception preconsumption), perceived consumption (volume perception postconsumption), and actual amount consumed, are investigated systematically. Our results suggest that one's eyes can fool one's stomach.

Accurate volume judgments are complicated processes that require estimation of linear dimensions and their aggregation per normatively correct formulas. Heuristic processors of real-world, three-dimensional information are likely to simplify the volume judgment task in terms of one or two dimensions, which can lead to systematic biases in volume perceptions. Our preceding examples, far from demonstrating anomalous consumer behavior, may reflect the standard way in which consumers make volume judgments. In this article, we explore which dimensions dominate heuristic processing of volume judgments; the ensuing perceptual biases; the manner in which these perceptions are amended in the face of experiential sensory inputs; and the implication of these biases for marketers interested in package choice, actual consumption, and postconsumption satisfaction. Results of seven studies show that elongation of a container has a positive effect on volume perceptions, actual consumption, package preference, and package choice but a negative effect on perceived consumption and postconsumption satisfaction. Although volume perceptions have been studied extensively in cognitive psychology, albeit with inconsistent results, they have not received much attention in marketing. Consumption perceptions, to our knowledge, have not been studied previously. This is puzzling because both volume and consumption perceptions have many implications for package shape decisions.

Package shape decisions are increasing in importance for managers. For example, a manufacturer of paper cups is facing competition from a company that makes larger cups. The manufacturer wants to design a larger paper cup that maximizes perceived volume for the same amount of raw material. What shape cups should it make? There does not appear to be conventional wisdom regarding package shapes, and a variety of shapes abound in the marketplace. Although many shapes are now part of the brand image (e.g., the Coca-Cola bottle), for a new product introduction, manufacturers must decide on the dimensions of the package. To the extent that consumers do not read volume information on the packaging, packages that appear larger will be more likely to be purchased, ceteris paribus. Volume estimation is also important if it affects actual consumption. Certain package shapes might represent a double-win situation; that is, they may be more likely to be chosen because they are perceived to be bigger, and because they are perceived to be bigger, they also may be consumed faster.

Apart from the marketing implications for packaging, this article also contributes to research in cognitive psychology. We propose and investigate the construct of perceived consumption. We also examine for the first time consequences of volume perception and perceived consumption for actual consumption. From a theoretical standpoint, we uncover an interesting illusion, the perceived size–consumption illusion (PCI). This illusion suggests that perceptions of volume, as a function of the elongation of a container, reverse before and after consumption. We theorize that this occurs because of the inconsistency between seeing and experiencing; that is, subjects' relative perceptions of two objects reverse before and after experiencing the stimulus. This illusion is related to a highly researched effect in the cognitive psychology literature, the size–weight illusion (SWI), which was documented more than a century ago (Charpentier 1891). The similarity in the two illusions—expectation based on perceptual input is contradicted by a sensory experiential input, which leads to a contrast effect (a reversal in the perception)—suggests that the nomological construct underlying the two illusions is the disconfirmed expectation.

The article is organized into four sections (see Figure 1) that systematically investigate the effect of package shape on volume perceptions, preference and choice, consumption (perceived and actual), and postconsumption satisfaction.

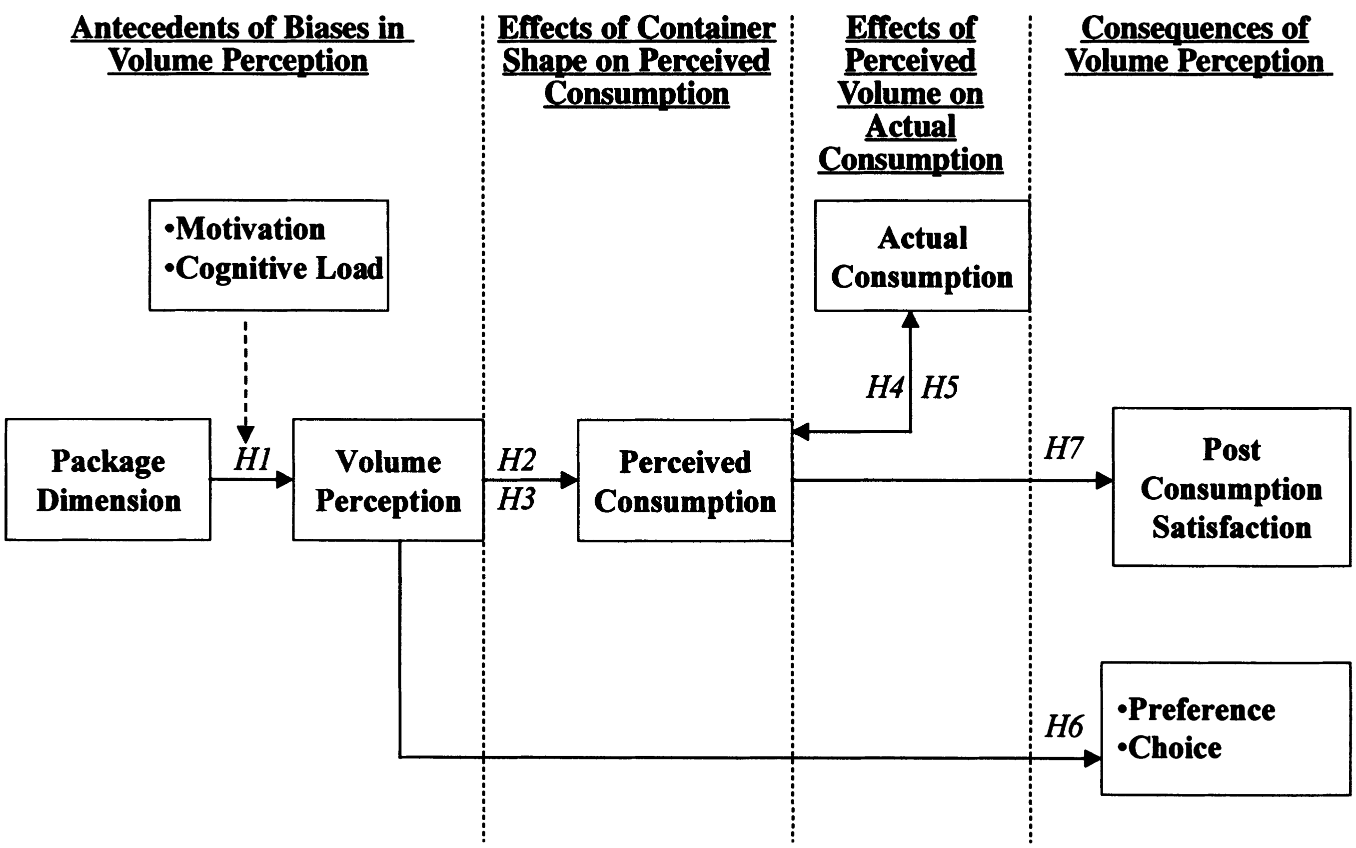
The first section explores the antecedents of volume perceptions. We summarize existing research from cognitive psychology on volume perceptions and test the elongation hypothesis, which states that taller containers are perceived to be bigger. Study 1 demonstrates this bias in volume perceptions for cylindrical shapes (cans, jars, bottles, and so forth). Study 2 examines whether the effect is attenuated in conditions of high motivation and strengthened under cognitive load. The second section introduces the construct of perceived consumption and explores consequences of biases in volume perceptions on perceived consumption. We summarize previous literature on the SWI and derive implications for the perceived consumption construct. Study 3 tests the effect of container shape on perceptions of consumption, holding both actual and consumed volume constant. The third section explores consequences of biases in volume perceptions (pre- and postconsumption) on actual consumption. Studies 4 and 5 measure the effect of container shape on actual consumption and test whether this effect is mediated by perceived consumption. The fourth section (Studies 5–7) examines the consequences of these biases, that is, whether the perceived volume effect translates to preference, choice, and postconsumption satisfaction. We conclude with theoretical implications for the manner in which consumers use visual cues to make spatial judgments and, more generally, the implications of sensory experiential inputs that contradict perceptually based expectancies. We also offer managerial implications for package design, communication, and pricing.

ANTECEDENTS OF BIASES IN VOLUME PERCEPTION

Judgments of size, area, and volume are far from trivial, requiring complicated formulas and calculations. Take a simple example of everyday occurrence. To compare volumes of two juice containers—one in a cuboid carton and the other in a cylindrical can (both 240 ml)—a consumer would need to make five linear judgments: the heights of the two containers, the width and depth of the cuboid carton, and the diameter of the cylindrical can. These linear estimates[2] then would have to be combined according to geometric formulas for the two shapes, which would need to be

[2]For cylinders, rather than using the linear estimate directly, the estimated diameter would need to be halved and the result squared to form the input for the next process. The value of the third parameter also would need to be retrieved from memory. For many consumers, this number may not be easily accessible.

Figure 1
ANTECEDENTS AND CONSEQUENCES OF VOLUME PERCEPTION



retrieved from memory. The resulting two numbers then would have to be compared to determine whether one container carried more juice than the other. Of course, consumers instead might read the label of the container. However, research consistently has demonstrated that consumers seldom read details beyond the final price of the product and, often, not even that (Dickson and Sawyer 1986). Furthermore, decisions of this nature are made by millions of consumers multiple times a week, if not every day. In addition, they are made in a short period of time. Although the preceding example is a caricature of the normatively correct process involved when making volume judgments, the purpose is to illustrate that, because of the level of effort involved in making accurate judgments, consumers are likely to resort to judgment shortcuts in a tradeoff between effort and accuracy (Payne, Bettman, and Johnson 1988).

When the level of accuracy desired does not warrant the effort required, consumers may resort to simplifying rules of thumb, or heuristics, for volume judgments. They may rely on one or two dimensions and ignore or underweight the third to make volume estimation easier. Although most researchers studying volume judgments would agree with this proposition, there is no general agreement on whether these effects, which have been shown in children, continue for adults.

Prior Research on Biases in Volume Judgment Due to Shape

More than 50 years ago, Piaget studied children's perceptions of volume. In a typical Piagetian experiment, colored liquid was poured from a tall cylinder into a shorter, wider cylinder. The height of the liquid in the second cylinder was lower. Children then were asked whether the volume of the liquid had remained the same or had been reduced. Those who recognized that the volume had remained the same were exhibiting "conservation of mass." In a series of studies, Piaget (1968; Piaget, Inhelder, and Szeminska 1960) found that primary school children appeared to use only the height of the container when making volume judgments; they believed that the volume had been reduced when the liquid was poured into a wider glass. The predominant use of a single dimension—height—to make three-dimensional judgments was termed the "centration hypothesis."

Using Piaget's experiments as a basis, Holmberg (1975) proposed the elongation hypothesis, in which height was conceptualized not in terms of an absolute metric but in units of width. This hypothesis stated that the greater the height-to-width ratio of a container, the greater was the estimated volume. Holmberg found support for this hypothesis using both cylindrical and cuboid shapes. Frayman and Dawson (1981) tested the elongation effect for cylinders and found weak support for the effect. At low volumes (<128 cubic centimeters [cm^3]), elongation has a significant effect on perceived volume, with short cylinders perceived to be smaller than medium and tall cylinders. However, as the volume of the cylinders increases in absolute terms, the elongation effect reduces, with no significant differences in volume estimates (by elongation) for cylinders >1024 cm^3. Support for the elongation effect also is found by Been, Braunstein, and Piazza (1964) and Pearson (1964); if two cylinders of equal volume are reduced to new identical volumes, one by reducing the height and the other by reducing the width, the cylinder whose height is reduced appears smaller.

It is not clear, however, that the elongation effect is robust enough to carry across contexts and experimental procedures. Specifically, it is not clear if these effects translate to consumer judgments of volume for frequently purchased products. They may not for several reasons. First, many of the experiments previously reported were conducted with grade school age and younger children and indicate that estimation procedures change as the subjects become older (e.g., Piaget, 1968; Piaget, Inhelder, and Szeminska 1960). Second, the experiments used stimuli that were constructed per the experimental design of the researcher (e.g., styrofoam or white cardboard by Fraymon and Dawson 1981; gray painted wood by Holmberg 1975) and were not familiar to subjects. Consumers, in contrast, are typically familiar with the containers of frequently purchased products, such as soda cans and jam jars, and may have their own consumption experiences to guide their volume estimate. This might make them less susceptible to an elongation effect. Third, in many of the studies previously reviewed, volume judgments were elicited using apparatuses that consumers would not use in natural settings. Holmberg (1975), for example, used an apparatus for which the subject had to turn a knob for raising or lowering a cylinder through a hole in a plane to match the volume of a given object. This leaves the question of whether adult consumers would make biased volume judgments of familiar containers. In Study 1, we test the following:

H_1: Holding actual volume constant, more elongated containers are perceived to have higher volumes.

Study 1: The Effect of Container Shape on Perceived Volume

Method. Subjects were 40 undergraduate business students at the Hong Kong University of Science and Technology, who completed the experimental task for partial course credit. Their average age was 21 years. Thirty-five (87.5%) were female students, and five were male students. Thirty-seven (92.5%) were right-handed.

Twenty-seven cylindrical boxes, jars, and bottles of commonly used packages (e.g., beer cans, cheese balls, baby food, and so on) were collected. Packages chosen were commonly purchased products at the university supermarket/coffee shop (see Table 1). Packages chosen differed in shape so that there was a wide variation in height (from 3.4 to 27.9 cm), maximum width (from 2.15 to 10.2 cm), and actual volume (from 90 to 2330 ml). Each container was covered with white paper to disguise its brand name and conceal all volume information.[3]

[3]Note that disguising the boxes also may reduce subjects' use of experiential information to estimate volume.

Table 1

DESCRIPTION OF STIMULI USED IN STUDY 1

Description	*Material*	*Height (cm)*	*Maximum Width (cm)*	*Minimum Width (cm)*	*Elongation*	*Volume (ml)*
1 Gerber with a blue lid	Glass	7.7	2.5	1.8	1.54	125
2 Chutney container	Glass	6.2	2.9	2.7	1.07	135
3 Gerber "Third Foods"	Glass	8.5	2.15	2.0	1.98	175
4 Robertson's preserve (340 gm)	Glass	10.4	2.9	2.6	1.79	285
5 Skippy Peanut Butter (340 gm)	Plastic	8.0	3.2	3.15	1.25	330
6 Marjoram Flakes (.4 oz.)	Glass	8.7	2.0	1.8	2.17	90
7 Spice Island's Cinnamon Sticks	Glass	10.2	1.6	1.5	3.19	120
8 DairyFarm Yogurt (475 gm)	Plastic	10.5	4.8	3.8	1.09	520
9 Meadow Lea Margarine (250 gm)	Plastic	3.4	5.9	5.0	.29	330
10 Meadow Lea Margarine (500 gm)	Plastic	6.9	5.8	4.75	.59	570
11 San Miguel Beer (330 ml)	Tin	10.9	2.9	2.8	1.88	340
12 Centrum Vitamins	Plastic	9.7	2.45	2.1	1.98	175
13 Kraft Cheez Whiz (250 gm)	Glass	10.1	2.6	2.2	1.94	240
14 Maya Chilli Chutney (237 ml)	Glass	13.0	2.6	2.6	2.5	240
15 Glass box with white lid	Glass	13.0	2.7	2.6	2.41	360
16 Ahmed's tandoori paste	Glass	11.0	3.1	2.9	1.77	310
17 Planters Peanuts (340 gm)	Cardboard	8.7	5.1	5.1	.85	635
18 Planters Cheez Balls (141 gm)	Cardboard	17.1	10.2	10.2	.84	1250
19 Nestlé Coffee Mate	Glass	16.5	3.5	3.5	2.36	650
20 Calistoga Mineral Water (296 ml)	Glass	16.5	2.7	1.2	3.06	305
21 Maritinelli's apple juice (296 ml)	Glass	9.7	3.0	1.7	1.62	315
22 Calistoga juice (296 ml)	Glass	17.8	2.7	1.75	3.3	305
23 Knudsen papaya nectar (236 ml)	Glass	14.0	2.5	1.7	2.8	245
24 Orangina drink (200 ml)	Glass	13.6	2.4	1.2	2.83	200
25 Coca-Cola (1 litre)	Plastic	27.9	4.4	1.2	3.17	1205
26 Planters Cheez Balls (262 gm)	Tin	19.5	7.5	7.5	1.3	2330
27 Pedigree Dog Food (700 gm)	Tin	13.8	4.25	4.25	1.62	730

Notes: Actual volume (last column) may differ from package description (column 2). Measures of both maximum and minimum width are given to account for variation in shapes.

Among the cylindrical containers found in the marketplace, there was a high correlation between surface area viewed head-on (i.e., the shelf facing area, or height × maximum diameter) and volume (R = .90). Height also was correlated highly with actual volume (R = .60). However, elongation (height/maximum diameter) was correlated weakly with actual volume (R = –.19).

Subjects were tested individually. They were told that the experiment was concerned with how people made judgments under time pressure. The experimenter presented the different packages one at a time and asked the subject to arrange the packages in ascending order of volume. The order of presentation was randomized and different for each subject. To reduce noise in the estimates, subjects then were shown a can of Diet Coke as a reference and told that its volume was 355 ml. They were asked to estimate the volume (in ml) of each of the 27 containers in either ascending or descending order, counterbalanced between subjects.

Results and discussion. To test H_1, we estimated regression models, with estimated volume as the dependent variable and height, or a variable based on height (e.g., elongation or surface area), as the predictor variable. Several alternative models were run to identify the most parsimonious model and counter any alternative explanations for regression results (because container shapes had not been manipulated systematically to control for the presence of other variables that potentially could affect volume estimates, such as material, surface area, and so forth). The results of six of these models are reported in Table 2. Both height and elongation (Models 1 and 2) have a significant effect on perceived volume (βs = 12.55, 3.91; t = 7.35, 4.58; R^2 = .703, .694, respectively), even when actual volume is included in the regression equation.[4] Models 3 and 4 show that height affects perceived volume beyond surface area. Surface area is significant if height is not included in the equation (Model 3: β = 2.49, t = 6.37) but drops to nonsignificance with the inclusion of height (Model 4: β = .88, t = 1.57).[5] Surface area and height have a high correlation (R = .69).

The containers were of four different materials: glass, tin, plastic, and cardboard. Model 5 suggests that the material also may affect volume perceptions; plastic containers were perceived as larger than glass containers (β = 37.18, t = 2.06). This is consistent with previous research in cognitive psychology that shows that the makeup of a shape (material, color) can affect the perceived size of the shape (Gundlach and Macoubry 1931). Model 6 indicates that the shape of the container significantly affects perceived volume beyond actual volume and height.

The results show that height in an absolute or relative sense (versus elongation), both on its own and along with the width dimension (e.g., surface area), affects volume perceptions substantially. Taller shapes are perceived as larger than shorter ones. We investigate this elongation effect in the remainder of this article. Specifically, in the next study, we examine the robustness of the elongation effect under

[4]Deriving the most appropriate psychophysical model for estimated volume is not the purpose of this article. Thus, it is not our objective to determine whether height or elongation is a better predictor of estimated volume. Both support H_1.

[5]We thank reviewers for suggesting that we perform regressions incorporating surface area, container material, and container shape.

Table 2
REGRESSION MODELS FOR STUDY 1

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*
Actual volume	.63 (35.0)	.72 (48.72)	.69 (46.56)	.64 (33.43)	.62 (24.73)	.64 (34.61)
Height	12.55 (7.35)	—	—	9.77 (3.99)	13.22 (7.14)	9.44 (4.23)
Elongation[a]	—	39.1 (4.58)	—	—	—	—
Surface area[b]	—	—	2.49 (6.37)	.88 (1.57)	—	—
Dummy for tin[c]	—	—	—	—	–7.65 (–.27)	—
Dummy for plastic	—	—	—	—	37.18 (2.06)	—
Dummy for cardboard	—	—	—	—	33.22 (1.05)	
Shape[d]	—	—	—	—	—	9.68 (2.14)
R^2[e]	.703	.694	.699	.703	.705	.704

[a]Height/(maximum diameter/width).
[b]Height(maximum diameter/width – minimum diameter/width). This model explained higher variance than two others that used height(maximum diameter/width) and height(minimum diameter/width).
[c]The base for the material dummies is glass.
[d](Maximum diameter/width – minimum diameter/width)^2.
[e]As comparing across the R^2s of the different models demonstrates, the parsimonious height/elongation models (1 and 2) explain a large amount of the variation. Addition of parameters does not reduce their parameter values or substantially increase the model predictiveness.
Notes: Table 2 entries represent parameter estimates (t-values) of the tests for parsimony of parameters and alternative explanations for the elongation heuristic.

manipulations that shed light on the theoretical antecedents of the use of height as a volume heuristic.

Study 2: Does Container Shape Affect Perceived Volume Automatically?

There are two possible reasons for the use of the height heuristic. Consumers may use the heuristic either consciously to reduce the effort involved in making a complex three-dimensional judgment, knowing that this may lead to a less accurate judgment, or in an automatic, unintentional manner (cf. Bargh 1989). If the use of the height heuristic is a controlled decision, then increasing motivation to make an accurate judgment should reduce the bias and increasing cognitive load should increase the bias. Conversely, if it is automatic, the bias should be robust and less likely to be moderated by ability or motivation manipulations, particularly if height forms the initial input for a volume judgment (e.g., Gilbert 1989). On the basis of prior research that has demonstrated that the use of salient visual cues to make a spatial judgment has an automatic aspect (Raghubir and Krishna 1996), we expect the elongation effect to be robust to motivation and ability manipulations.

Method. Subjects were 20 undergraduates at the University of California at Berkeley, who participated in the study for partial course credit. The experimental task was to estimate the capacity of two five-ounce glasses, one a tall, fluted champagne glass and the other a round wine glass. All subjects were asked to judge the volume of the two glasses. Cognitive load was manipulated by asking subjects to listen to a tape and count the number of times a word beginning with the letter "t" was spoken. Low load subjects heard the tape but were asked to disregard it. All subjects were given a 90-second time limit to complete the task. To ensure that they took the task seriously, all subjects also were given an incentive for accuracy. There was a $50 reward for the subject who made the most accurate estimate depending on the task (volume estimate in the low load condition and estimation of words starting with a "t" in the high load condition). Subjects were asked to estimate the volumes of the two glasses in fluid ounces (ozs.), which served as the dependent measure, and to rate the difficulty of the volume perception task on a seven-point semantic differential scale ("Not at All"/"Very Difficult"), which served as the manipulation check.

Results. The volume estimation task was rated easier by those in the low load condition (Mean = 3.63) than in the high load condition (Mean = 2.70; $F(1,16) = 2.03$, $p < .10$),[6] which suggests that the manipulation worked as intended.

The analysis was a 2 (ability) × 2 (elongation) ANOVA, with the first factor between subjects and the second within subjects. The dependent measure was volume perception in fluid ozs. As predicted by H_1, the taller glass was perceived to be larger (Mean = 6.69) than the short glass (Mean = 6.12; $F(1,14) = 4.90$, $p < .05$), irrespective of whether subjects had paid more attention to the volume estimation task or the tape ($F < 1$ for all effects involving ability). Thus, ability did not emerge as a moderator of the shape effect. The study shows that the effect of elongation is robust; increasing processing ability and motivation to make an accurate judgment does not reduce it. This result adds to literature documenting that the use of visual cues to make spatial judgments may be partially automatic (Raghubir and Krishna 1996).

Apart from neither demanding nor consuming cognitive effort, automatic processes are characterized as uncontrollable, unintentional, and outside conscious awareness (Bargh 1989). If the use of elongation as a visual cue to make volume judgments is automatic by these criteria, its effect should follow when volume judgments incorporate additional sources of information, such as actual consumption. In the next section, we examine the implications of this bias in perceived volume when it confronts actual experience, specifically, when the experience contradicts the prior expectation. To do this, we must consider the implications of container shape for consumption. We next introduce the construct of perceived consumption and examine how the elongation of a container affects it.

EFFECTS OF CONTAINER SHAPE ON PERCEIVED CONSUMPTION

There is a rich literature on expectancy disconfirmation (for a review, see Stangor and McMillan 1992) and illusory correlation (Chapman and Chapman 1969) in social psychology and on learning from experience in marketing (Hoch and Deighton 1989). Much of the expectancy disconfirmation literature focuses on recall and recognition of information that is congruent versus incongruent with expectations, leading to a contrast away from initial expectations. Stangor and McMillan perform a meta-analysis of 54 such experiments and show that incongruent information is recalled better than congruent information when the information involves behaviors rather than traits.

Although the expectancy disconfirmation literature in social psychology focuses on traits and behaviors of others as inputs, some expectancy disconfirmation literature in cognitive psychology focuses on self-experienced sensory inputs. This latter literature is more germane to our research, because we want to study perceived consumption, a self-experienced sensory input. A highly researched effect of this genre is the SWI. Charpentier (1891) first demonstrated the SWI, in which bigger objects of the same weight were perceived to be lighter. For example, a pound of cotton wool seemed lighter than a pound of lead. Since then, many others (e.g., Luczak and Ge 1989; Sarris and Heineken 1976; Usnadze 1931; for a review, see Jones 1986) have replicated the effect.

Several explanations have been proposed for the SWI. The most accepted are based on expectancy theory and divided broadly into two streams. One suggests that the bias is haptic in nature (i.e., due to touch); the other suggests it is visual in nature. In the haptic stream of research, Woodworth (1921) proposes that prior experience with objects leads observers to expect that a large object will be heavier than a smaller object. This sets up expectations that could affect the force an observer applies when lifting an object. A greater lifting force applied to a larger object causes the larger object to be judged lighter (see also Davis and Roberts 1976; Ellis and Lederman 1993; Nakatani 1985; Pick and Pick 1967; Ross 1969).

In the visual stream, on the basis of his information integration model, Anderson (1970) argues that size, or volume, is an object property that affects perceived heaviness along

[6]Note that degrees of freedom are 16 because of partial nonresponse to this question.

with weight. Size affects perceived heaviness through an expectation of how heavy an object of that size should be. Specifically, Anderson proposes the Averaging Model, in which the judged heaviness of the object as seen and lifted is a function of the weighted average of felt (but not seen) weight and expected (seen but not felt) weight (see also Cross and Rotkin 1975). Masin and Crestoni's (1988) results also support the visual hypothesis. They control for both haptic information, by having the object lifted by pulling on a string going through a pulley, and volume expectations, by showing the stimulus but manipulating the time at which it was seen. They find that the SWI occurred when vision was allowed (i.e., the volume expectancy could be developed) but only when the object was viewed at the same time it was lifted. If viewing was prior to lifting, the SWI disappeared. In summary, though there is still some controversy regarding the basis of the SWI, the prevalent view appears to be that people expect the smaller object to be lighter. However, when they actually lift the small object, their experience contradicts their expectation, leading to a contrast effect. The opposite is true of the large object. This results in the smaller object being perceived as heavier than the larger object. There is also evidence to show that this illusion may be partially automatic, in as much as it is uncontrollable, because it does not reduce when subjects are told that the objects weigh the same (Flournoy 1894).

We propose that perceived consumption is analogous to perceived heaviness, in as much as it is a function of (1) an initial perceptual visual input (volume) and (2) a subsequent experiential sensory input (actual consumption). We expect that a similar perception–experience illusion occurs in the consumption scenario: When subjects see a tall glass, they perceive it to be larger than a short glass, but when they start drinking, their experience contradicts their expectations. Because it is less voluminous than they expected, they believe that they have consumed more from the container they expected would contain less, the shorter container. This effect, the PCI, is stated formally as follows:

H_2: Perceived consumption is greater when the container is less (versus more) elongated, holding actual volume consumed constant.

Note that the PCI requires that consumers have expectancies based on elongation of the container. This suggests that volume perceptions should mediate the effect of elongation on perceived consumption:

H_3: The effect of elongation on perceived consumption (H_2) is mediated by its effect on volume perceptions (H_1).

Study 3: Perceived Volume–Consumption Switch

In this study, we test for the PCI, a reversal in perceptions of volume pre- versus postconsumption. We examine whether the same person finds the taller glass to contain more (H_1) and believes he or she has drunk more from the shallower glass (H_2) and whether the effect of elongation on perceived consumption is explainable by the effect of elongation on perceived volume (H_3).

Method. Subjects were students in a graduate marketing class at Columbia University. The experiment has two phases: In week 1, H_1 was tested, and in week 2, H_2 was tested. There were 18 common data points across the two phases of data collection, which were used to test the perception reversal within subjects and examine the mediation hypothesis (H_3.)

In week 1, subjects were informed that the study was being conducted by an established plastic cup manufacturing company that was interested in getting their opinions on two new designs of cups it was thinking of introducing. Subjects were given two cups of identical volume (10 fluid ozs.) but different shapes, one more elongated than the other. The more elongated cup had an approximate height of 8.6 cm and a base diameter of 4.8 cm. The less elongated cup had a height of 7.8 cm and a base diameter of 5.0 cm. Subjects were asked to estimate the capacities of both cups (in fluid ozs.), which served as the dependent measure to test H_1. For a benchmark, they were told that a can of soda has 12 fluid ozs. The order in which volume was estimated for the two cups was counterbalanced. Subjects also were asked questions regarding the aesthetics of the two cups to maintain the cover story. Consistent with the cover story, they were asked to choose which cup they found more appealing. The two cups were marked with letters selected at random.

In week 2, the same cups were filled to half their capacity with water.[7] Subjects were told the following:

> We are an established plastic cup manufacturing company that wants to diversify into mineral and spring waters. We have just come up with two new formulations of spring water that we would like you to try. To get a good idea of both the products, we would like you to finish the entire spring water in both glasses over the class session. Also, we would like you to start with one glass, finish it completely and then drink from the other glass. Please start with glass L (or P). Turn to the next page when you have finished both glasses.

Again, both cups were marked with letters selected at random. Order of tasting was counterbalanced across subjects. Subjects were asked which taste they preferred and how much they believed they had consumed from each cup. To make the cover story more believable, they also were asked how often they bought spring water, which brand they bought, and when they consumed it (e.g., after sports, with meals).

Results. A 2 (measures: perceived volume versus perceived consumption) × 2 (shape: tall versus short) ANOVA showed that, though the two main effects were significant ($F(1,17) = 50.42$ and 11.72 for shape and measure, respectively, $ps < .01$), their interaction was also significant ($F(1,17) = 16.25$, $p < .001$). Although the perceived volume of the taller cup was greater (Mean = 9.050) than that of the shallower cup (Mean = 7.750; $F(1,17) = 23.15$, $p < .01$, $\eta^2 = .577$), as predicted by H_1, the opposite was true for perceived consumption. In support of H_2, consumption was perceived as lower for the taller cup (Mean = 4.722) versus the shallower cup (Mean = 5.056; shape contrast $F(1,17) = 2.27$, $p < .10$, $\eta^2 = .118$). Thus, both H_1 and H_2 were supported.

To test H_3, we conducted a mediation analysis to determine whether the effect of cup shape on perceived consumption was mediated by perceived volume estimates. This is by far the strongest test of the hypothesis that people expect the shorter cup to contain less liquid and that this ex-

[7]They were not filled to capacity to minimize consistency pressures between the two phases of data collection.

pectation is what drives their perception that they have consumed more from it. As per Baron and Kenny (1986), to establish mediation, we must demonstrate that (1) the independent variable (shape of cup) affects the dependent variable (perceived consumption). This test is significant (H_2 results); (2) the independent variable (shape of cup) affects the proposed mediating variable (perceived volume). This test is also significant (H_1 results); and (3) the effect of the independent variable (cup) on the dependent variable (perceived consumption) reduces to nonsignificance (perfect mediation) or in effect size (partial mediation) when the analysis incorporates the mediating variable (perceived volume) as a covariate, whereas the effect of the mediating variable is significant. This demonstrates that the variance that was explained previously by the independent variable now can be explained by the mediating variable, which implies that the independent variable exerts its effect on the dependent variable indirectly through the mediating variable. This analysis is reported next.

An ANCOVA on perceived consumption of the two cups, including perceived volumes of the two cups as covariates, shows that the effect of shape of cup, which was significant without the covariate, reduced to nonsignificance when the covariate was added ($F(1,14) = .02, p > .90, \eta^2 = .001$). The effect of the covariate was marginally significant, despite the small sample size ($F(1,16) = 2.27, p < .10, \eta^2 = .124$), and the beta coefficient was in the expected direction ($\beta = -.35, t = 1.51$).

This result supports the proposition that the switch in relative volumes from the taller to the shallower cup in the preversus postconsumption task is due to a contrast between what is expected and what is experienced.[8] In the next section, we explore the implications of this on actual (as opposed to perceived) consumption.

EFFECT OF PERCEIVED VOLUME ON ACTUAL CONSUMPTION

Prior research has proposed (Assuncao and Meyer 1993; Blattberg et al. 1978) and demonstrated (Wansink and Deshpandé 1994; Ward and Davis 1978) that stockpiling has a direct effect on consumption. The reasons offered are that lower unit cost through stockpiling on a deal stimulates consumption (Assuncao and Meyer 1993) and that consumers want to bring their inventory down to an acceptable level (Blattberg et al. 1978). This research suggests that consumption is related positively to inventory levels. This effect may be due to higher actual volume, higher perceived volume, or both.

Studies holding actual volume constant have demonstrated that package size positively affects consumption (Folkes, Martin, and Gupta 1993; Wansink 1996; but for null results, see Moore and Winer 1978). Specifically, Folkes, Martin, and Gupta (1993) propose that large packages lead to higher consumption because consumers are less worried about replacement transaction costs. Wansink (1996) suggests that the same effect may be observed if consumers believe that larger packages have lower unit costs, and so, even holding actual volume constant, larger package sizes may lead to greater consumption. Other reasons suggested for the effect of stock volume on usage volume are that larger packages are more difficult to control and thus lead to overpouring (Stewart 1994) or that consumers are eager to finish larger package sizes because of inventory holding costs (Hendon 1986).

These studies have examined the effect of actual differences in volume or differences in package size on usage. We now suggest that, even holding actual volume and package size constant, to the extent that consumers believe different shaped containers have different volumes, container shape can affect consumption level. Thus, we hypothesize that the positive effect of actual volume on usage will translate to the domain of perceived volume. Based on Studies 1–3, consumers would consume more from more elongated containers, which are perceived to be larger—a direct effect of perceived volume on actual consumption.

An alternative route for the same effect is by perceived consumption. One of the implications of the PCI is that when subjects see a tall glass, they perceive it to be larger (H_1), but when they start drinking from the glass, they realize that it is not as big as they thought. They then overcompensate, as is reflected in lower estimates of perceived consumption (H_2 and H_3). This also may result in overcompensation in their actual consumption from the glass. That is, the overcompensation might lead to their drinking more from the elongated glass than from the less elongated glass. Such a mechanism points to an indirect effect of perceived volume on actual consumption through perceived consumption. It implies that consumption will be greater the more elongated the container is. Thus, we expect the following:

H_4: The more elongated the container, the greater is the actual consumption.

H_5: The effect of elongation on actual consumption (H_4) is mediated by perceived consumption (H_2).

Study 4: Do People Drink More from Taller Glasses?

Method. Subjects were 16 graduate students who engaged in the experiment as part of a class at Columbia University. The study is similar to a typical Piaget mass conservation experiment (Piaget, Inhelder, and Szeminska 1960). We used a one-way between-subjects design, with shape of container manipulated at two levels (shallow glass versus tall, deep glass). The glasses were the same as those used in Study 3, that is, of identical capacity and containing the same volume. At the beginning of class, subjects were told that an established soft drink company that had not yet marketed cola wanted their opinions on two formulations it had developed. It was giving them a glassful of each so they could get a true feeling of the formulation. Subjects were

[8]Because the PCI is a novel finding, we replicated it with some methodological variations to test for robustness. The experiment was conducted with 37 undergraduate students at a Hong Kong business school. Two cups of identical volume (8 ozs./240 ml) but different heights (8.5 versus 5.75 cm) were chosen. Their base diameters were within a quarter-inch of each other (elongated = 5.25 cm, shallow = 5.5 cm).

Under the guise of a taste test, both cups were filled with 7-Up or Sprite (actual volume = approximately 222 ml), and subjects were asked to drink one of the cups completely before drinking from the other. Order of cup and brand of soda tasted first was counterbalanced between subjects. After disposing of the two cups, subjects estimated how much they had drunk from each. This question was embedded among other questions to make the cover story realistic.

Results support H_2 and replicate Study 3. Subjects estimated that they had consumed a smaller volume from the tall cup (163.51 ml) versus the short cup (175.68 ml; $F(1,36) = 4.12, p < .05$).

told to drink as much or as little as they wanted of either formulation and that they could switch back and forth between formulations to determine which was better. Which glass the subject drank from first was counterbalanced across subjects. At the end of the class, subjects were asked which of the two formulations they liked more, which glass was more appealing to them, how much soda they drank in a week, and their gender. The amount left in the glasses was measured after the completion of the experiment and used to compute actual consumption.

Results and discussion. H_4 was supported. The analysis was a repeated measures MANOVA, with consumption as the dependent variable, shape as the within-subjects independent variable, and the two counterbalancing orders as between-subjects independent variables (which glass's capacity they estimated first and which glass they drank from first). The MANOVA revealed a significant effect for shape; the more (versus less) elongated glass had greater consumption (Means = 6.91 versus 6.20 ml; $F(1,12) = 23.07$, $p < .0001$). Neither order of administration factor exerted main or interaction effects. Elongation did not affect any other measures. Thus, actual consumption is greater from more elongated glasses. The next two studies examine the route by which elongation affects actual consumption.

Study 5: Delineating Mediation Paths

Method. Thirty-three undergraduates, drawn from the same pool as used in Study 2, participated for partial course credit. The glasses from Study 2 were used as stimuli (tall fluted and round wine 5-oz. glasses). The study had two parts. In the first part, subjects estimated the volumes of the two glasses. Subjects then performed an unrelated task for approximately 30 minutes. The second task was assigned between subjects. Subjects had to choose one of two locations in the experimental room. These locations had been set up with either the tall or the short glass. Subjects had to consume three types of snack foods—one pretzel thin, two corn chips, and three potato chips, in that order—under the guise of a taste test for snacks. They were asked to drink enough water between the tastings "to remove the taste of the snacks." One experimenter walked around with a bottle of water to refill glasses, taking care to only refill glasses that were completely empty. The other experimenter unobtrusively recorded consumption (by quarter glass). After filling in questions to keep the cover story intact (e.g., which snack was saltiest, which made them thirstiest, which was the easiest taste to remove, and which taste they liked best), all subjects were asked to estimate the amount of water they had drunk (in fluid ozs.) to remove the taste of each snack. This measure was used for perceived consumption. The elaborate snack food guise was required to reduce suspicion that the two parts of the study were related, reduce demand artifacts, and control for order effects due to prior measurement of volume perceptions. There was a suspicion check at the end of the study to identify anyone who guessed that the two parts of the study were connected. At the end of the study, subjects were asked to help themselves to the remaining snack food and were excused.

Results and discussion. Six subjects indicated suspicion of a connection between the two parts of the study and were removed from the sample. Another did not complete all the measures, leaving a usable sample of 26 subjects to test the hypotheses.

As predicted by H_1, the shorter glass was estimated to contain 5.6 ozs., as compared with the taller glass, which was estimated to contain 6.0 fluid ozs. ($F(1,22) = 4.67$, $p < .05$).

H_2 made a directional prediction for perceived consumption, holding actual consumption constant. In this study, as actual consumption varied, the directional prediction was inappropriate. Thus, we computed a measure for which a directional prediction is possible:

$$\text{Perceived Consumption Error} = (\text{Perceived Consumption} - \text{Actual Consumption})/\text{Actual Consumption}.$$

Per H_2, the perceived consumption versus actual consumption should be greater for the short glass compared with the tall glass. The means are in the correct direction (Error = .48 versus .34 for the short and tall glass, respectively; $F(1,24) = 2.39$, $p < .10$, one-tailed).

Subjects in the tall glass condition consumed more water on average than those in the short glass condition (Means = 8.4 versus 6.9 fl ozs.; $F(1,24) = 1.96$, $p < .10$, one-tailed), in support of H_4.

To examine whether volume perceptions directly mediated the effect of container shape on actual consumption or if this effect is through perceived consumption, as was hypothesized (H_5), we conducted two separate ANCOVAs. In the first, the difference in perceived volume between the tall and short glass, as elicited in the first part of the experiment, was included as a covariate in the ANOVA on actual consumption. The effect of elongation marginally increased ($F(1,23) = 2.15$), and the covariate was not significant ($F < 1$), which is not consistent with a mediation pattern (Baron and Kenny 1986). The second ANCOVA used the perceived consumption error as the covariate. This analysis shows a strong mediation pattern: The effect of the covariate is significant ($F(1,19) = 12.72$, $p < .01$) with the sign in the correct direction ($\beta = -.62$), whereas the effect of elongation drops to $F < 1$, the conventional level of a null effect. This pattern supports H_5 and indicates that the route to increased actual consumption is mediated by the effect of elongation on perceived consumption.

The results of this study replicate the elongation effect on volume perceptions and actual consumption; elongated glasses are perceived to contain more prior to consumption, and actual consumption is greater from these glasses. These results suggest that managers should construct more elongated containers so that consumers believe they are bigger and consume them faster. This, however, is contingent on consumers preferring a container that is perceived to be larger. We now test for this effect.

CONSEQUENCES OF VOLUME PERCEPTION

We first reanalyze some of the data collected as part of Study 5 to test whether consumer perceptions of volume translate to choice. Next, we report results of two additional studies that examine whether the elongation effects translate to preference and postconsumption satisfaction. The formal hypothesis tested is as follows:

H_6: The more elongated the container, the more it is preferred.

Study 5: An Extension to Choice

Method. In Study 5, all subjects (n = 33) had to choose one of two locations in the experimental room to complete the second part of the experiment. This part of the experimental procedure was run between subjects. There were an equal number of locations with a tall or a short glass. Thus, subjects were constrained by the availability of a glass when choosing their seat, and a person who wanted a tall or short glass may not have gotten one. The order in which the glasses were picked shows which glasses were chosen more readily by subjects.[9]

Dependent variables. We measure the difference in preferred choice between the tall and short glasses in the following three ways:

1. The difference in the mean rank, or the mean order in which the glasses are chosen. If there are four glasses and the choice order is tall-short-tall-short, the mean ranks are two (i.e., [1 + 3]/2) for tall and three (i.e., [2 + 4]/2) for short. The lower the mean rank, the higher is the preference;
2. The mean availability across all choice occasions. In a situation of choice without replacement, if a glass is preferred, it will be chosen more readily and have lower availability; thus, the higher the availability for the tall or short glass, the lower the preference for it is; and
3. The mean availability conditional on choice. A tall (short) glass may be chosen because it has high availability or in spite of its low availability. Availability of tall (short) glasses across occasions on which they were chosen reflects whether glasses were chosen because of high availability or in spite of low availability. The higher the mean availability conditional on choice, the lower the preference is. Thus, if there are four glasses and the choice order is tall-short-tall-short, the availability for the tall glass across the four choice occasions is 2/4, 1/3, 1/2, and 0/1, which yields a mean availability of .3333 across all four occasions and a mean availability of .50 across the two occasions on which the tall glass was chosen. Similarly, the availability for the short glass on the four choice occasions is 2/4, 2/3, 1/2, and 1/1, which results in a mean availability of .6667 across all four choice occasions (or one mean availability of the tall glass) with a mean availability of .83 across the two occasions, conditional on the short glass being chosen.

Results. Study 5 was conducted in two sessions with 13 and 20 students, respectively.[10] The mean rank for the tall glass is lower in both session 1 (Means = 3.67 versus 9.86 for tall and short glasses, respectively; $p < .001$ using the Wilcoxin-signed ranks test[11]) and session 2 (Means = 9.2 for tall and 11.8 for short; $p < .001$). The mean ranks show that, on average, the tall glass was chosen before the short glass.

In session 1 (n = 13), the mean availability across all choice occasions was .1563 for the tall glass versus .8437 for the short glass. The pattern is the same in session 2, in which the mean availabilities are .3688 versus .6362 for the tall and short, respectively (n = 20). Although these two proportions are not significantly different from .5 because of their small sample sizes, the direction of the difference supports H_6.

If we observe only the mean availability conditional on choice, in session 1, the mean availabilities are .32 for the tall glass when the tall glass was chosen (n = 6) versus .96 for the short glass when the short glass was chosen (n = 7; proportions different from each other at $p < .05$). In session 2, the mean availabilities are .44 versus .71 for the tall and short, respectively (n = 10 each; proportions different from each other at $p < .05$).

Thus, H_6 is supported. These analyses demonstrate that the tall glass was preferred to the short glass. We may conjecture that this occurred because the subjects preferred glasses that appeared larger.[12]

Study 6: An Extension to Preference

Subjects (n = 53), drawn from the same pool as Studies 2 and 5, were shown the two glasses used in Studies 2 and 5 and asked which glass they preferred. An overwhelming majority (77%, or 41 of 53 subjects) preferred the tall glass to the short one ($p < .01$). Ten preferred the short glass, and 3 subjects were indifferent between the two. Thus, the elongation effect translates from the judgment to the preference domain. Note that the elongation effect should extend to preference only in conditions in which more is preferred to less. In situations in which consumers wish to minimize volume for reasons of storage capacity (e.g., yogurt) or consumption (e.g., candy bars), the managerial implication of offering a larger-looking container size is unclear.

Study 7: An Extension to Postconsumption Satisfaction

Postconsumption satisfaction should be based on the amount people believe they have consumed. Thus, the effect of elongation on postconsumption satisfaction should be in the same direction as its effect on perceived consumption rather than on actual consumption. Thus, we predict the following:

H_7: The more elongated the container, the lower is postconsumption satisfaction, given that actual consumption is the same.

Method. Subjects (n = 40) were drawn from the same pool as Studies 2, 5, and 6 (no subject participated in more than one of these studies), and the stimuli used was the same—round wine and tall fluted glasses. The experiment had two parts: volume perception and consumption, with their order manipulated between subjects. That is, half completed the volume perception measures prior to consumption, as in Study 5, whereas the other half completed these measures postconsumption. This was to rule out the possibility that our previous results were due to order of measurement. The volume perception part of the experiment was akin to Study 5, in which subjects estimated volume for both the short and the tall glass.

The cover story for the second stage of the experiment was that it was a taste test for juice. Subjects were given a (tall or short) glass filled with 4.5 ozs. of a fruit juice drink and asked to drink it as they would normally. After answering an open-ended question about its taste, to increase credibility of the cover story, subjects rated the juice using a seven-point scale in terms of how satisfying it was ("Not at All"/"Very"). Because satisfaction is a function of both perceived volume and taste, we also collected closed-ended

[9]An experiment with replacement of glasses would have given a more direct measure of choice for tall versus short glasses. However, data without replacement of glasses were required to test the consumption hypotheses.

[10]The first session had six tall and seven short glasses.

[11]We treated a tall and a short glass as one pair and rank-ordered the differences in ranks for the Wilcoxin test.

[12]Note that height is not the only feature that is different between the taller flutes and the shorter, round wine glasses. Their shape also differs, and this could potentially influence subjects' choices.

measures of taste, including how fruity and refreshing the juice was. Besides the perceptual measure for satisfaction, we determined satisfaction with a more behavior-based measure. We asked subjects whether they wanted a refill of the glass ("Definitely Not"/"Definitely Yes"). To the extent that subjects did not find the drink satisfying, they should be more likely to want a refill.

Results. There were no significant order effects on any of the measures, and accordingly, order is ignored.

In support of H_1, regarding volume perception and replicating previous studies, the taller glass was perceived to contain more (Mean = 6.91) than the shorter glass (Mean = 6.46; $F(1,38) = 4.03$, $p < .05$).

Regarding postconsumption satisfaction, an ANOVA on the satisfaction measure, using type of glass as the independent variable and including fruitiness and refreshing ratings as covariates, showed that the juice was perceived to be more satisfying when sipped from the short glass compared with the tall one (Means = 5.85 versus 5.55; $F(1,36) = 2.96$, $p < .05$, one-tailed). Both covariates were significant. Thus, the shape of the glass affected postconsumption satisfaction. Consistent with the PCI, this can be explained by consumers' perceived consumption being greater from the shorter glass.

An ANOVA on the refill requests, though not significant, provides further support to this finding. Those drinking from a tall glass wanted a refill to a greater extent than those drinking from the short glass (Means = 4.90 versus 4.35; $F(1,37) = 1.48$, $p < .12$, one-tailed), and refill requests were related to how satisfying they found the juice ($F(1,37) = 2.82$, $p < .10$).

In summary, in this section, we investigated the consequences of the effects of shape on volume perceptions before and after consumption. We found that more elongated containers are preferred and are more likely to be chosen preconsumption but are believed to be less satisfying than less elongated containers of the same volume. We now discuss the implications of our results for theory and practice.

GENERAL DISCUSSION

In this article, we examine the effect of elongation on (1) perceived volume, (2) perceived consumption, (3) actual consumption, (4) postconsumption satisfaction, and (5) choice. As described in Figure 1, our model suggests that package shape directly affects perceived volume and, through this, indirectly and inversely affects perceived consumption. Perceived consumption, though occurring subsequent to actual consumption, affects the amount consumed; the less people think they are drinking, the more they drink to compensate. Thus, the net effect of elongation on actual consumption is positive and by way of the perceived consumption route. Perceived consumption, in turn, affects postconsumption satisfaction directly, which implies that the net effect of elongation on satisfaction is negative. Finally, the positive effect of elongation on volume perception translates to preference and choice.

Specifically, based on the literature in cognitive psychology, we propose that consumers use the simplifying heuristic of a container's elongation to estimate its volume. An empirical test shows that, even for frequently used and purchased package shapes, this is true. The more elongated the container, the greater the perceived volume of the container is (Study 1). This robust effect may be explainable using Study 2 results, which are consistent with the proposition that the use of elongation to judge volume may be partially automatic. We then proposed the construct of perceived consumption and related it to the robust SWI from cognitive psychology. We proposed that the SWI is a specific case of a more general perceptual–experience illusion and that another manifestation of that illusion is the PCI. The PCI proposes that perceived consumption is related inversely to the perceived volume of a product. Study 3 demonstrates this effect and provides evidence that the contrast effect is mediated by an expectancy disconfirmation. This is a novel finding in both the cognitive psychology and marketing literature. Next, we examined the implication of container shape on actual consumption. In Studies 4 and 5, we found that the effect of container shape on actual consumption mirrored the pattern of perceived volume (i.e., the more elongated the container, the greater the consumption from that container is) and that this was due to the effect elongation had on perceived consumption. Studies 5–7 showed that the perceived volume effect translated to preference, choice, and postconsumption satisfaction.

Our research builds on previous work in both psychology and marketing and examines the antecedents and consequences of biased volume perceptions. We find that an object's elongation affects consumer judgments and behavior in simple though not always intuitive ways.

Theoretical Implications

The PCI and the manner in which it affects actual consumption is of theoretical interest to information processing researchers. At a general level, this is a paradigm in which there is a judgment based on two sources of information (volume and consumption) that are inconsistent with each other. The sequential nature of the two information sources places the former as a reference against which the latter is processed. This results in a contrast effect due to the inconsistency between the two information sources—a taller container appears larger in volume versus a shorter container, but when consumed from, it does not appear to contain as much volume as expected. Although contrast effects have been demonstrated using attitudinal data, this research shows these effects with less ambiguous sensory inputs. To our knowledge, this is the first time an effect of this type has been documented in marketing.

Our research also introduces volume perceptions as an area of study. Whereas prior research has focused on the consumption effects of higher actual volume (Wansink and Deshpandé 1994; Wansink and Ray 1992, 1996), we focus on the effects of perceived volume. Because many consumers do not read the labels on packages that declare true volume (Dickson and Sawyer 1986), the effects of perceived volume seem important to study. Furthermore, we introduce the concept of perceived consumption to marketing and psychology research. Although smell and taste always have been accepted as perceived stimuli, consumption as a perceived stimulus has not been investigated.

The set of seven studies shows that consumers are prone to biases in volume judgment. Consumers may use the height of the package to anchor their volume estimates and then adjust their volume perceptions subsequently to account for width and shape differences. A similar anchor and adjust process has been suggested to apply to distance perception (Raghubir and Krishna 1996) and numerosity estimates (Krishna and Raghubir 1997). Similar to Gilbert, Pelham, and Krull (1988), we also propose that the initial anchor may be an automatic input with subsequent adjustment a more controlled process (Raghubir and Krishna 1996).

Managerial Implications

Our studies demonstrate that certain shapes are perceived to be bigger in volume than others of identical volume. This is demonstrated with the most common shapes used for food items (e.g., cans and glasses) and frequently purchased package shapes (e.g., soda cans). In addition, it is demonstrated using stimuli that are actual package shapes picked off grocery shelves. Therefore, if people do not read the volume information on the package, packages that appear larger will be more likely to be purchased, ceteris paribus. Thus, manufacturers may find it beneficial to sell products in certain types of package shapes. We also find that perceptions of larger volumes are associated with larger consumption (Studies 4 and 5). Therefore, more elongated packages may present a double-win situation for managers; not only are they more likely to be purchased, but after being purchased, they also will be consumed at a faster rate. However, they may lead to lower postconsumption satisfaction, though this may induce greater consumption (Study 7).

For purchase decisions, it has been assumed that consumers subconsciously focus on purchasing the package that has lowest unit cost (Isakson and Maurizi 1973). If they do not read package labels and unit price information, consumers may choose the package that appears largest if the set of brands has similar (or equal) prices. This implies that perceptions of package volume become important. It has not been tested if consumers (1) would focus on which package looks bigger at the time of purchase or (2) would remember their feelings of postconsumption (dis)satisfaction from the previous purchase. For "one-shot" purchases, or when consumers have not tried different package shapes, packages that appear larger would be purchased because postconsumption satisfaction would have no role in the purchase decision. We also propose that, even if consumers have tried different packages, they use visual perception rather than their postconsumption satisfaction, because temporal distance makes the former more salient. In addition, with larger interpurchase cycles, postconsumption dissatisfaction may be difficult to recall. We have shown (in Study 1) that consumers perceive more elongated packages to be larger, even when they are frequently purchased packages. This would indicate that disconfirmation of package size after consumption may not lead consumers to revise their volume judgments sufficiently in the long term. With short interpurchase/interconsumption cycles, postconsumption dissatisfaction may be easy to recall and therefore salient. However, this suggestion needs further research.

Our findings are important for managers because package shape decisions can have a major impact on a company's sales. For example, in 1984–85, Lipton India elongated the shape of Lipton tea packages. Unit sales increased by more than 10%.[13] Our studies also have implications for shapes of different package sizes of the same brand. If a manufacturer has different package sizes, should it maintain the same ratio along dimensions, and therefore maintain the shape (i.e., a cube remains a cube, just a larger one), or should it keep the width the same and increase the package size along the height dimension? Our findings suggest that the latter would result in the larger size being perceived as even larger. Another argument is that the manufacturer should have the most elongated package shape for the package size it is keen on selling overall. This should result in consumers thinking of this package as a better value for money and, generally, in larger sales.

The package shape decision also has implications for pricing and communication. The Hong Kong–based distilled bottled water company, Watson's, decided to increase the volume of its small size bottled water from 700 ml to 800 ml. Competitors sell a 770 ml bottle. Can Watson's charge a higher price for the new bottle? Should it maintain the symmetry between height and width or elongate the bottle? If the height of the bottle remains unchanged (to make storage easier), does Watson's need to bring the higher volume of the bottle to consumers' attention or will consumers easily spot this change? Watson's must consider if it should advertise that its new bottle is larger than its old one and larger than its competitors' bottles. Our results indicate that Watson's should market its new bottled water in a more elongated bottle, particularly if it wishes to charge a higher price. If Watson's does not elongate the bottle, it definitely should advertise the size change, as consumers may underestimate the increased volume.

Downsizing decisions (reducing volume while keeping price the same) also must account for volume perceptions. Several well-known brands are downsizing rather than cutting price, and less than a quarter of them report a negative impact (Adams, di Benedetto, and Chandran 1991). Adams, di Benedetto, and Chandran (1991) report that when Charmin downsized its roll from 500 to 380 sheets in early 1987, and then to 350 sheets, the package price remained unchanged, the paper sheets were fluffed up to reduce the visible effect of downsizing, and packaging communication focused on "fluffiness." There was no negative impact of downsizing on Charmin. It appears that consumers did not realize that the effective price increase was 8%. This example shows that the issue of volume perception is important for reasons of consumer welfare. If companies charge a higher price for their product because they expect consumers to estimate them to be bigger than competing brands, consumers must be made aware of their own biases in volume perception.

Study Limitations and Areas for Further Research

Although we showed that elongation increases perceived volume, it is important to determine boundary conditions for this effect. For example, does the effect only hold when height is salient, and not when width is more salient than height? How well does the model make predictions for consumer products across form categories; that is, how do boxes compare with bottles? Are there limits to the elongation effect at a particular elongation ratio; that is, what happens to perceptions of the volume of test tubes? What happens to volume and consumption biases as packages become more familiar? Do they get reduced, or do they persist even in sit-

[13]This information was obtained through personal communication with a brand manager.

uations of high familiarity? What happens if new package shapes are introduced that are counter to expectations for the category set by competitors? Does this exacerbate the bias as consumers' volume estimation task becomes more difficult?

In our experiments on consumption, the liquid was poured into the containers for the subjects. Another interesting issue for further research is whether consumers would pour different amounts of liquid into containers that appear to be of different volumes.

Another direction for additional research is to study biases in area perceptions of nearly two-dimensional products, such as pizzas, cookies, and so forth. What are the implications of the manner in which volume judgments are made for area judgments? Is the area judgment task easier than the volume judgment task, thereby resulting in reduced use of heuristics and less biased size estimates? Furthermore, a more rigorous specification of the manner in which different dimensions are aggregated would lead to greater specificity in predictions. How do consumers integrate the height and width dimensions to make a size judgment? Is it through the use of the simple elongation parameter, such as height in terms of width, or is it through an additive or other process? Furthermore, though in this article we did not disentangle the constructs of elongation and height (when height was manipulated, elongation was manipulated, and vice versa), a more rigorous model specification would assist in identifying which of these constructs has better predictive validity in volume estimates.

In this study, we focused on one dimension of packaging shape—elongation. However, many other aspects of packaging conceivably could affect perceived volume and consumption, for example, aspects of package shape other than elongation, color, material, aesthetic appeal, and so forth. Study 2 shows that the use of elongation as a source of information may be partially automatic. This research could be extended to test whether consumers have an inability to control their reliance on the elongation heuristic even when they are aware of the elongation bias (Bargh 1989). If so, the question of how to educate consumers so they are less prone to these biases becomes an important public policy issue. Will consumer education be useful, or must the manner in which products are packaged be regulated so that volume information is highly salient?

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