"Glasses' Makeup: the simple and the combined effect of color and shape on perceived volume and beverage intake"

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Abstract

In order to understand the context of beverages' intake, it is crucial to bear in mind that there are a wide number of environmental cues which affect both the frequency and the volume ingested by consumers (Wansink, 2004). The horizontal-vertical illusion and the size-contrast illusion are the main causes to the biases regarding the amount of beverage consumed, inasmuch it is known that consumers use heuristics to make area and volume assessments (Krider, Raghubir and Krishna, 2001; Raghubir and Krishna, 1999). Hence, it is relevant to consider cues such as the shape and the size of packages, containers, (Folkes and Matta, 2004; Krider, Raghubir and Krishna, 2001; Raghubir and Krishna, 1999; Wansink and Park, 2001; Wansink and Ittersum, 2003; Wansink, 1996; Wansink, Van Ittersum and Painter, 2006) in what regards to their impact on both perceived and actual consumption. However, the simple and combined effect of color and shape on perceived consumption and intake via the effect of the vertical-horizontal illusion on the perceived amount of beverage has been disregarded in the past. The results of the experiment conducted showed that glasses' elongation positively influences the perceived volume, while indirectly and inversely affects perceived consumption, the amount of sparkling water being constant on the experiment. Nevertheless, the experiment failed to show the simple and the combined effects of color and shape on volume perceptions and volume ingested by subjects.

Key words: Color, consumption, elongation, glasses, intake and volume perception.

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Project's purpose

According to several studies, the severity of the obesity epidemic may be influenced by beverage intake (National Center for Chronic Disease Prevention, 2006). In fact, the changes in eating patterns in the past decades are strongly associated with the increase of caloric intake (Nielsen, Joy and Popkin, 2003). The increase of soft drinks consumption was the major contributor to total caloric intake for many individuals, principally children and adolescents (Nielsen, Joy and Popkin, 2003; Striegel-Moore et al., 2005). The consumption of sugar-sweetened beverages must be considered when analyzing caloric ingestion, inasmuch beverages are one of the principal causes of added sugars in worldwide diet (National Center for Chronic Disease Prevention, 2006). According to the same paper, the impact of beverage consumption on body weight is inconsistent across different studies. The research conducted by Striegel-Moore et al. (2005) and Ludwig, Peterson and Gortmaker (2001) reveals that the consumption of sugar-sweetened drinks had a significant association with body mass index (BMI) that may lead to the "risk of overweight". However, to Newby et al. (2004), the intake of soft drinks or sodas and the change in intake of these beverages were not significantly associated with weight or change in BMI. To understand the differences between these studies, it is important to explore the context of beverage consumption, since there are a wide number of variables which affect both the frequency and volume ingestion of consumers (Wansink, 2004). Studies have shown, for instance, a strong relationship between portion sizes and intake levels (National Center for Chronic Disease Prevention, 2006; Wansink, Painter and North, 2005), both for pre-served portions and in self-serving settings (i.e., when consumers decide the serving portions). It is important to emphasize, which contributes to a significant proportion of the daily caloric requirement for an adult or child, has increased in the last decades (National

Center for Chronic Disease Prevention, 2006). When implementing new marketing strategies to attract new customers, restaurants and other sites did not hesitate to increase portion sizes, which lead people to consume more and more (Nestle, 2003; Young and Nestle, 2003). Those strategies were translated in a higher overall energy intake due to the significant caloric content of the referred portions (Ledikwe, Ello-Martin and Rolls, 2005; Rolls, Morris and Roe, 2002). According to the research conducted by French et al. (2001), there is a positive association between eating at fast food restaurants and the increase intake of soft drinks. The increase in obesity may also be explained by the number of soft drinks purchased out of home, especially at school (School Health Policy and Program Study, 2000), which are energetically dense and are sold in large portions (McCrory, Fuss, Saltzman and Roberts, 2000). Hence, it is important to implement methods that help to reduce consumers' intake, namely the manipulation of volume or energy density (Osterholt, Roe and Rolls, 2007). As shown before, when simply manipulating size and shape, variables that were proven to affect volume perceptions, it is possible to drastically diminish consumers' intake (Folkes and Matta, 2004; Krider, Raghubir and Krishna, 2001; Raghubir and Krishna, 1999; Wansink and Park, 2001; Wansink and Ittersum, 2003; Wansink, 1996; Wansink, Van Ittersum and Painter, 2006).

In short, it is crucial to understand the context of everyday beverage consumption and the variables which affect drinking environment, in order to promote relevant strategies and to gauge the feasibility of the proposed strategies. It is also important to consider the multiple incentives and barriers to reduce intake in any given context (National Center for Chronic Disease Prevention, 2006).

Brief literature review

Piaget, Inhelder and Szeminska (1960) highlight the importance of elongation on biases in volume judgment. According to their research, primary school children value a single dimension-the height-to make volume judgments. In fact, children fixed their attention on a portion of the field (the vertical dimension), while adults focused their attention on the isolation and analysis of the other dimensions such as the vertical and horizontal dimensions (Piaget, 1969). In this context, the vertical-horizontal illusion is one of the causes that bias consumers, regarding volume judgments. According to the research conducted by Raghubir and Krishna (1999), given the underestimation of width when compared to height, consumers perceived taller containers to hold a great volume of liquid than shorter ones, even when the two dimensions are matched in size. There is an expectancy disconfirmation at the consumption phase, because the actual volume lies below the perceived amount. This fact leads to consumers perceiving the consumed volume to be lower than it actually is and, consequently, consumers poured an extra amount into the glass to make up for the resulting dissatisfaction. For this reason, for more elongated containers, the actual consumption rate was higher (Raghubir and Krishna, 1999). Consistent with the previous results, the experiments conducted in self-administered scenarios point out people pouring greater amounts of liquid into less elongated glasses given the great underestimation of volume relative to their taller counterparts (Wansink and Ittersum, 2003).

Consumers' judgment regarding perceived volume is also affected by other factors, namely the shape of a package (Krider, Raghubir and Krishna, 2001). The shape of a package had a positive influence of salience of one of its dimensions on perceived volume, holding everything else constant including actual volume. Folkes and Matta (2004) revealed that the salience of attributes other than dimension may also affect volume perceptions. Another crucial factor that biases consumer's perceptions and judgments is the size-contrast illusion that influences both intake intention and intake perceptions, since the effect of the visual cues were stronger than the actual intake level (Wansink, Painter and North, 2005). Packages and container's size have also been shown to affect consumption volume, since larger packages are perceived as having smaller unit costs (Wansink, 1996) and they might unintentionally increase the amount considered reasonable for consumption (Wansink, 2004). Package size has also been shown as an external cue that affects consumption volume, even across different levels of perceived taste (Wansink and Park, 2001). The authors suggest that it can also negatively influence consumers' attention and perception regarding the amount ingested. However, other academic studies (Folkes, Martin and Gupta, 1993) reveal that it is not the size of the package, but rather the amount of the contained product that determines usage levels, since the authors established a direct connection between the package size and the residual product when perceived by consumers. Hence, for Wansink, Painter and North (2005) it is clear that consumers regulate their consumption to the portion sizes, inasmuch as they established a measure of the amount considered suitable to consume.

There are a number of social factors that need to be valued when analyzing consumption. For instance, according to Herman, Polivy and Roth (2003) the context and the influence of peers have a double influence on consumption, since they can increase or decrease consumption. When people feel observed, or when they are in the company of dear friends, or even when they want to be socially accepted (Bell and Pliner, 2003), the same people adjust their consumption patterns to the message they expect to bind (Wansink, 2004).

Color is another feature that is crucial when investigating consumption, as it can suppress consumers' appetite (Design: Spatial Color, 2007). According to this research, the quantity of food or beverage consumption would increase depending on the impact of the color. In reality, the consumption was influenced by food color or even by the color of the rooms where the study was conducted. This study divulge that yellow is the most appropriate color for stimulating the appetite and not red as previously thought, since people consume twice as much in the yellow room, compared to the red room.

Contextualization

It is crucial to understand the visual illusions and their influence on consumer behavior, as this basic knowledge is very important to designers. In fact, the visual illusion influences consumers, inasmuch they usually are implemented to hoodwink consumers into buying more. However, these illusions can be used in a very positive way as they may improve user experience and increase post-consumption satisfaction (Stevenson, 2008). The majority of people tend to be biased by visual illusions, even after they are made aware of their direct effect, due to a semi- automatic response in the processing of the information in mind (Raghubir and Krishna, 1999). It has been shown, when dealing with a certain stimulus, the mind can misunderstand it, assuming that as routine of reality. This is due to the focus on prior patterning rather than on contextual observation (Stevenson, 2008). According to Stevenson (2008), the visual illusion occurs when images visually perceptible differ from objective reality, this is when the mind conjectures about something in the visual field. The same author suggests that the information gathered by the eye is processed in the brain, interpreting the world in three spatial dimensions. Conversely, the visual illusion makes the system vulnerable in that a reality will be explored with two-dimensional imagery.

However, according to Raghubir and Krishna (1999), the three dimensional information can lead to misjudgments of volume perceptions, since it simplifies too much the volume judgments tasks in terms of one or two dimensions. The role of visual illusions is to provide insights in the elongation problems, inasmuch as the effects of elongation in consumption are very rigorous (Stevenson, 2008). Taller shapes are perceived as having higher capacity compared to their shorter counterparts, leading to some disappointment on consumers when they perceive that the real volume of liquid consumed is lower than the expected one (Raghubir and Krishna, 1999).

The vertical-horizontal illusion is intrinsically related with the size-weight illusion. According to the research conducted by Charpentier (1891), when comparing two objects of identical weight, usually the smaller of the two is judged to be heavier when lifted, the so called size-weight illusion. When analyzing the weight of a given object, not only its physical weight should be considered, but also its size.

The size-weight illusion is strongly influenced by the shape of an object, namely by the color of it (Raghubir and Krishna, 1999). According to Gundlach and Macoubrey (1931), there is a correspondence between the effect of color in size and luminosity, since light objects appear comparatively large and dark objects comparatively small. The same authors also find that, there is a consistent effect of color on apparent size and this is shown to be directly related to the luminosity of the colors involved.

The existence of various illusions and the impact of color in some of these illusions can influence consumer behavior consistently in what concerns consumption. However, there are environmental factors that constrain the consumers' perception in what concerns to the perceived volume consumed and the real volume taken in (Wansink, 2004). Furthermore, consumers are not aware of the impact of those factors, since they strongly believe that their misinterpretation of the volume ingested is not influenced by the underlined factors (Wansink, 2004; Wansink, 1996). Whereas the impact on consumption of the size and shape of packages and containers (Folkes and Matta, 2004; Krider, Raghubir and Krishna, 2001; Raghubir and Krishna, 1999; Wansink and Park, 2001; Wansink and Ittersum, 2003; Wansink, 1996) as well as color (Design: Spatial Color, 2007) have been previously studied the simple and combined impact of color and shape on volume perception and consequently consumption have yet to be addressed.

The objective of this paper is to further deepen this subject by assessing the impact of color and shape on the perceived volume of beverages and actual consumption levels.

What are the simple and the combined effects of color and shape on perceived volume? What are the simple and the combined effects of color and shape on intake? As using more elongated glasses may reduce consumption by biasing consumers' perceptions of how much was consumed, colored and elongated glasses may also be used to influence consumption. The resulting bias might lead to an impact in actual consumption levels while holding perceived consumption constant.

This research may provide a more thorough understanding of the relationship between color, shape and consumption, showing that the makeup of a glass, in this case its color and shape can affect the perceived size and the perceived consumption.

Discussion of the topic

According to some academic studies (Krider, Raghubir and Krishna, 2001; Raghubir and Krishna, 1999), there are a number of rules related to consumers' assessment of areas or volume of geometrical shapes or irregular figures that must be considered in what concerns volume perceptions. According to Raghubir and Krishna (1999), it is obvious that the height of the container or its elongation influence consumers' volume judgments. For the same authors, containers that are taller or elongated are recognized as holding more volume than containers that are shorter. This is due to the fact that consumers visually approach the object as a whole, undervaluing a particular dimension of it (Raghubir and Krishna, 1999). The "Height Heuristic" leads consumers into error, since it endorses judgment biases regarding volume perceptions.

On the other hand, Folkes and Matta (2004) center their research on irregular container shapes. The authors take into account a number of experiments in which they realize that, when consumers are confronted with an irregular container shape and another regular one, both similar in size, they tend to consider the asymmetrical one larger than the standard container. This bias on volume judgments is the result of the covariance of attention and size, as people are unconsciously stimulated to focus their attention on larger shapes rather than smaller ones. In fact, when considering a container's elongation, consumers tend to perceive the more elongated one as holding more volume than its shorter counterpart, without knowing on what basis they make that particular judgment (Raghubir and Krishna, 1999).

Another important issue when analyzing the elongation effect is the perceived-size consumption illusion (PCI). According to Raghubir and Krishna (1999), consumers perceive the volume of a container differently before and after consumption. When considering the function of elongation of a container, they realize that consumers see and experience dissimilar stimulus, since their perceived consumption is inversely related to the apparent volume of a product. According to the PCI, volume and consumption are incompatible with each other, inasmuch as there is a discrepancy between the two information sources (seeing/experiencing): although a taller container is considered as holding more volume than a shorter one, when the consumption occurs, the actual volume is less than the perceived one (Raghubir and Krishna, 1999). Based on the discussed literature, it may be hypothesized that:

H1. a) The larger the perceived volume of the glasses, the higher the consumption holding actual volume constant.

According to the research conducted by Raghubir and Krishna (1999), both height and elongation play an important role in perceived volume. However, the same authors reveal that there are other shapes' features that can affect volume perceptions, namely the makeup of shape (color). In fact, these results are consistent with prior research in cognitive psychology that divulges that the form of a shape, in this case the color, can influence the perceived size. In fact, the effect of color on apparent size and weigh was investigated by Warden and Flynn (1926), revealing that the inherent qualities of the colors lead to greater color weight illusion when compared with color-size illusion. Nevertheless, apparent weight is changed by color, when visual perception alone is employed, but when visual plus kinesthetic perception is used the effect of color on perceived weight produces ambiguous results, since the effect of color on perceived weight is unreliable (Gundlach and Macoubrey, 1931). The same authors demonstrated that the findings of Warden and Flynn's study (1926) cannot be confirmed, in what concerns the impact of color on apparent size. Their investigation confirmed that the color has an impact on apparent size, since light objects appeared comparatively large and dark objects comparatively small. The results of this academic research showed that color have a distinct and a reliable effect on apparent size and this effect is influenced by the luminosity of the colors involved.

According to the literature previously mentioned, regarding the impact of color on apparent size, as light objects are perceived as larger when compared to darker ones, it may be hypothesized that:

H2. a) The perceived amount of liquid tends to be considered relatively larger on a light than on a dark glass.

Based on the literature, regarding the volume judgments of elongated containers, as the taller glass is perceived as holding a great amount of volume when compared to its shorter counterpart, it is possible to hypothesize that:

H2. b) The perceived amount of liquid tends to be considered relatively larger on a tall than on a short glass.

However, it is crucial to understand the combined effect of color and size of a glass on volume perception, since prior studies were not able to fill the gap about this effect. It may therefore be suggested that:

H2. c) There is an interaction between color and size on perceived amount of liquid.

The main objective of this research is to verify the impact of color and shape on perceived volume. Previous empirical studies reveal that color has an effect on perception, evaluation, taste and behavior. Unfortunately, the number of studies that describe the effect of color on the evaluation beverages is reduced. Guéguen's research (2003) demonstrated that colored glasses have an impact on the evaluation of beverage's thirst-quenching quality. This research established that the color of glasses plays an important role on evaluation of beverages, inasmuch the color became information that is intrinsically related with a taste quality (glasses of cold colors were perceived as containing the most thirst-quenching beverages, when compared to glasses of warm colors). The research conducted by Hoegg and Alba (2006), revealed that the color of a drink can influence consumers perception of taste, as the authors said: "color dominated taste". For instance, when given two glasses of the same orange juice, one darker than the other, subjects perceived differences in taste that did not exist. However, when given two cups of orange juice similar in color but different in taste (one was sweeter than the other) the same subjects were unable to perceive the difference in taste.

Experiment 1

Firstly, the goal of this experiment was to determine the effect of colored glasses (tall or short, dark or light) on perceived amount of liquid of a glass holding the volume and content (sparkling water) of the glass constant. Secondly, the purpose of this experiment is to determine the simple and the combined effects of color and shape on intake of sparkling water.

Subjects: Eighty students from FEUNL were approached in the campus' hallways from 6th to 8th of May and they were asked to do an experiment which consisted of eating two types of chocolate (one white and another black), and after they were questioned about the taste of the chocolate.

Design: The study involved a 2x2 between –subjects design involving glass shape (tall versus short) and glass color (light versus dark) (Appendix1).

Materials (stimuli): At the beginning of this experiment, two types of Toblerone chocolate were used: white and dark with 30 gr. The same amount of sparkling water (thirty centiliters) was served randomly in a tall glass (light or dark) or on a short glass (light or dark) with the same capacity (forty centiliters). The height of the form is 10 centimeters for the shorter glass (with a base diameter of 7 centimeters) and 12, 5 centimeters for the taller glass (with a base diameter with 6, 5 centimeters). It is crucial to refer that the color of glasses were pink (the dark color) and transparent (the light color).

Method and procedure: To each participant either the tall glass (light or dark) or the short glass (light or dark) was given. Subjects had to ingest the same amount of the two types of Toblerone: white and dark chocolate- under the guise of a taste test for chocolates. Subsequently, subjects were asked to drink enough sparkling water between the tastings "to remove the taste of the chocolates". The glass was filled with 30 centiliters of sparkling water. To make the story viable, each participant completed a questionnaire with questions like “Which chocolate is sweeter?”, “Which chocolate makes you thirstier?”, “Which chocolate is easier to remove the taste?” and “Which chocolate do you like more?” After the intake test, as they completed the questionnaire, subjects were requested to roughly estimate the volume of the glass used and briefly estimated the volume of sparkling water that they thought they have ingested. At the end of the experiment, their glass of sparkling water was measured and the leftovers were recorded, in centiliters, in order to assess the effect of colored glass perceived volume on the perceived amount of beverage/liquid. This measure will be used for perceived consumption.

The elaborated chocolate guise was required to reduce suspicion that sparkling water intake was not the focal point of this research, reducing demand artifacts and controlling order effects due to prior measurement of volume perceptions. At the end of this study, suspicion checks were made to identify anyone who had guessed the purpose of this study.

Dependent measures: To test the first hypothesis, the appropriate variables were perceived volume of the glasses and the volume of liquid (sparkling water) leftovers, in centiliters. To test the second hypotheses, the dependent variable used was estimated volume of liquid (sparkling water), in centiliters. This variable is contingent upon the same independent variables: color and shape.

Results: The data collected was analyzed using SPSS version 16.0. The reference value to determine the significance of the statistical test was 5%. Previous analysis were performed upon the estimated volume of the glass (in centiliters) and the estimated volume of the liquid (in centiliters), using the one-sample T-Test, and as the assumption of normal distribution of both variables is not verified (using Kolmogorov-Smirnov Test of normality), the results were confirmed with the non-parametric Wilcoxon Test, to check if the estimated volumes are consistent with the actual volumes, of 40 centiliters to the volume of the glass and 30 centiliters to the volume of the liquid. Then the actual volume of liquid intake (in centiliters), determined by the difference between the actual volume of the liquid (30 centiliters) and the volume of liquid leftover (in centiliters) is compared with the estimated volume intake, using the paired-samples T-Test and, again, as the assumption of normal distribution of both variables is not verified, the results were confirmed with the non-parametric Wilcoxon Test (Appendix 2). To test the first hypothesis, correlate analysis is performed between the estimated volume of the glass and the volume of liquid leftover, using the Pearson Correlation and, thus the assumption of normal distribution of both variables is not verified, confirmed by the Spearman Correlation. For the first part of the second hypotheses, the study of the relation between the perceived amount of liquid and the color of the glass, the independent samples T-Test is used and, since the assumption of normal distribution is not verified for both variables, confirmation is obtained with the non-parametric Mann-Whitney test. For the second part of the second hypotheses, the statistical procedure is exactly the same as the previous one. The Univariate General Linear Model is used to study the third part of the second hypotheses, with the estimated volume of the liquid as dependent variable and the color and size as fixed factors. Multivariate General Linear Model can also be used to determine the effect of both color and size of the glass in both estimated volume of the liquid and estimated volume of the glass.

The relation between the estimated volume of the glass and the volume of liquid leftover (Appendix 3) is studied using the Pearson correlation (r_{79}=0,065, p=0,568) meaning that there is a slightly positive correlation: the larger the estimated volume of the glass the higher the volume of liquid leftover and the lower the consumption, but the relation is not statistically significant. As the assumption of normal distribution of both variables is not met, as verified in the previous analysis, the hypothesis is confirmed by the Spearman Correlation (ρ_{79}=0,139, p=0,221), with exactly the same conclusion. Analyzing the results it is possible to verify that the first hypothesis (H1) is not verified.

To check if there are differences between the estimated volume of the liquid and the color of the glass (Appendix 4), the results of the independent samples T-Test (t_{77}=-0,524, p=0,602) shows no significant relation, and even more, the perceived amount of the liquid is higher for the dark glass (Mean=34,06 centiliters , SD=26,30 centiliters) than for the light glass (Mean=31,75 centiliters, SD=9,29 centiliters), again the assumption of normal distribution is not verified for the measured variable in the dark glass (for the estimated volume of the liquid in the light glass K-S_{40}=0,113, p>0,200; for the estimated volume of the liquid in the dark glass: K-S_{39}=0,287, p<0,001), so the use of the non-parametric Mann-Whitney test (U=744,5, p=0,727) confirms the same conclusions. The H2.a) is not verified, and it is even contradicted by the sample average of the estimated volume of the liquid, higher in the dark glass when compared with the light glass.

To study the differences between the estimated volume of the liquid and the size of the glass (Appendix 5), the use of the independent samples T-Test (t_{77}=-4,458, p<0,001) produces significant results for the relation, showing that the perceived amount of the liquid is higher for the tall glass (Mean=41,80 centiliters, SD=23,97 centiliters) than for the short glass (Mean=24,21 centiliters, SD=6,84 centiliters), and since one more time the assumption of normal distribution of the estimated volume of the liquid does not occur in both types of glasses (for the estimated volume of the liquid in the tall glass K-S_{39}=0,344, p<0,001; for the estimated volume of the liquid in the short glass: K-S_{40}=0,156, p=0,016), the non-parametric Mann-Whitney test (U=134,5, p<0,001) should be used and it confirms the same conclusions. The H2.b) is confirmed, since the estimated volume (perceived amount) of the liquid is significantly higher for the tall glass when compared with the short glass.

Using the Univariate General Linear Model (Appendix 6), the estimated volume of the liquid is significantly related with the size of the glass (F_1=20,606, p<0,001), but not with the color of the glass (F_1=0,455, p=0,502) or the interaction effect between the size and color of the glass (F_1=3,320, p=0,072), thus there is no significant interaction between color and size on the perceived amount of liquid. The difference for average of the perceived amount of liquid in the tall and short glasses is higher in the dark glass (Tall: Mean=46,79 centiliters, SD=32,91 centiliters; Short: Mean=21,98 centiliters, SD=6,44 centiliters) than in the light glass (Tall: Mean=37,05 centiliters, SD=8,61 centiliters; Short: Mean=26,45 centiliters, SD=6,64 centiliters).

Using the Multivariate General Linear Model (Appendix 6), there is a significant effect of the size of the glass in both estimated volume of the liquid (F_1=20,606, p<0,001) and estimated volume of the glass (F_1=28,632, p<0,001), but there is no significant effect of the color of the glass in both estimated volume of the liquid (F_1=0,455, p=0,502) and estimated volume of the glass (F_1=0,155, p=0,695), neither of the interaction between color and size in both estimated volume of the liquid (F_1=3,320, p=0,072) and estimated volume of the glass (F_1=2,755, p=0,101). Given these results, it is possible to verify that H2.c) is not verified.

Discussion: Taking into account the previous results it is possible to infer that the Hypothesis 1) is not verify. In fact, the relation between the estimated volume of a glass and the volume of liquid leftover is not statistically significant. The results are not reliable as in previous academic research (Raghubir and Krishna, 1999; Wansink and Ittersum, 2003), inasmuch as there does not exist a strong positive effect on volume perceptions and a negative or positive effect on perceived consumption when elongation of a glass is taking into consideration. Indeed, the results of this experiment did not find an effect of glass shape on actual consumption, since this effect is “mirrored” by the pattern of perceived volume. There are some possible explanations for the prior outcomes that are related with errors of subject estimation volumes, since experiments occurred in a “multiple serving context”, with tastes’ differences among the subjects and with elongation’s unawareness effect. Regarding to the first reason, it is possible to verify that the lack of significant results in these analysis may be attributed in part to the error in the subjects’ estimates, as many demonstrated a lack of acquaintance of volume estimated, providing values that lay outside the sphere of adequate values. Furthermore, the insignificant results may also be endorsed to the fact that the experiment took place not in a self-administered setting, when people poured for themselves. According to the research conducted by Wansink and Ittersum (2003) people underestimated the volume of less elongated glasses when compared to their taller counterparts, leading to higher rate levels of consumption. In the current research, the same amount of sparkling water was served to each participant, which could lead to a bias at consumption phase, due to the PCI expectancy disconfirmation. The other plausible explanation may be the tastes’ differences among the subjects, concerning the type of beverage used. In fact, during the experiment some participants have confirmed their dissatisfaction with sparkling water and, consequently, the amount ingested may not be the most appropriated one. Furthermore, removing the taste of chocolate was the pretext used for the intake of sparkling water, and as a result some participants may have removed the taste more rapidly with a smaller amount of liquid, while other subjects needed more water to eliminate the flavor of chocolate.

These discrepancies between actual and perceived volumes are associated with unawareness of the elongation effect. In fact, during the experiment subjects were uninformed by the different size/shape variables and the different color of the glasses constituting one alternatively reason which may account for the insignificant results. Indeed, this alternative explanation may be taken into deliberation, when examining the pertinent results for the second hypotheses. The performance of the non- parametric Mann-Whitney Test on dependent variable (estimated volume of liquid, in centiliters) reveals a significant effect of size on it, inasmuch H2.b) is verified. Conversely, there is no statistical effect of color on this dependent variable and no interaction was found while color and size are considered mutually, ruling out both hypothesis H2. a) and H2.c).

The effect of size disclosed in the present study is consistent with previous academic research, since glasses' elongation plays an important role on biases in volume judgment. The unawareness of the participants about elongated glasses reinforces the subjects' misjudgments regarding glass and liquid volume perceptions, denoting the tendency that they have to be biased by visual illusion. This may be due to "Height Heuristic" according the study conducted by Raghubir and Krishna (1999). Although the experiments were developed in a multiple serving context, the results demonstrated that taller glasses are recognized as holding more volume than less elongated ones, leading subjects to underestimate the perceived volume of sparkling water ingested, as had been shown in prior studies.

In short, there was a significant statistical effect of size on dependent variable, since subjects visually approach the object as whole undervaluing a particular dimension of it (Raghubir and Krishna, 1999). Subjects tend to focus on previous patterning rather than on contextual observation, since the mind, when dealing with a certain stimulus, can misinterpret it, assuming that as routine of reality (Stevenson, 2008).

The results released in the present research, related to the effect of color on glasses, are not consistent with the research conducted by Gundlach and Macoubrey, (1931), as there is a lack of statistically significant results when combining color and size. As a consequence of that, light glasses did not appear comparatively larger and dark glasses did not appear comparatively smaller. One probable clarification for the lack of interaction between color and size is related to the fact that subjects focus their attention on the size of a glass instead on its color, since the human brain does not dissociate the object and its particular color (Grossman and Wisenblit, 1999). It is possible to check that during the experiment, since subjects did not developed any systematic pairing of stimulus to create a connection between the size and the color of the glasses, meaning that there was not any associative learning developed. In fact, subjects did not formulate a vast network of underlying color associations with shape of a glass throughout their experiment, and consequently, it is impossible to understand the paradigm of color on volume perception and beverage intake.

Overall results of size reflect the evidence that size plays a crucial role in judgments' process on the subjects, through the application of the "bigger is better rule". According to Silvera and Josephs (2002), in pairwise preference judgments of objects, single stimulus related to their size, color or shape do not have a significant impact, since consumers approach the objects as a whole according to their informational richness and their specific sociobiological functions.

Conclusions

A number of variables have been shown to affect consumption by biasing consumers' perceptions of the volume of beverage they have drunk (Raghubir and Krishna, 1999; Wansink and Ittersum, 2003). Following this notion, the manipulation of features such as the different sizes and shapes of glasses have been studied by some authors in the past (Raghubir and Krishna, 1999; Wansink and Ittersum, 2003). However, the impact of color on the perception volume of the glasses and intake has been previously disregarded.

The experiments conducted emphasize the importance of addressing glass shape as a significant environmental cue affecting beverage consumption, being consistent with previous research. When color is considered, there is no explicit impact on volume perception and beverage intake. The results of Experiment 1 reveal that glasses' elongation positively influences the perceived volume, while indirectly and inversely affects perceived consumption, the amount of sparkling water being constant on the experiment. The underlying rationale might be that the more elongated glasses originate a greater underestimation of consumption, inasmuch the actual volume lies below the perceived amount of beverage by subjects.

On the other hand, this experiment had shown that color does not really matter in what concerns to the size and the shape of glasses, inasmuch there is no significant interaction between color and size on the perceived amount of liquid. The reasons for that are related to the unawareness as well as to the lack of associative learning by subjects, since the existence of two dissimilar colors were not directly observable. In addition, it is not possible to develop an associative learning framework to explain subjects' physiological response to color.

Study Limitations and Areas for Future Research

Before discussing the implications of the research, it is crucial to understand that the glasses, although different, were substantially alike in what concerns to their height and diameter. Other limitation consists on the impossibility of the subjects to develop a mechanism that allow them to create the association color classic condition, so important to generate physiological responses to color, since there is impracticable to build a learning experience.

Further research should understand the importance of color in the perception of volume, since they are critical in cueing consumers in consumption situations (Grossman and Wisenblit, 1999). In fact, future fields should explore the color impact on different shapes, namely in self-serving situations and in using other dissimilar shapes. Moreover, future experiments should incorporate different types of beverages as well as a greater variety of different colored glasses in order to assess the marketing impact on the most popular brands among consumers. It would also be pertinent to understand why people associate a particular color to a particular object depending upon the situation or the mental connections that people have built about it. This could definitely be the first step to define boundaries of the impact of color preferences on consumption. As color influences the perception of the flavor, it would be a great achievement to show that it also has a repercussion on perceived volume.

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Appendix 1

- Height: 12,5 cm
- Diameter: 6,5 cm
- Capacity: 40 centiliters

- Height: 10 cm
- Diameter: 7 cm
- Capacity: 40 centiliters

Appendix 2

Previous analysis.

There are no significant differences between the estimated volume of the glass (Mean=39,79 centiliters, SD=21,92) and the actual volume of 40 centiliters, using the one sample T-Test (t_{78}=-0,087, p=0,931), but as the as the assumption of normal distribution is not verified (for the estimated volume of the glass: K-S_{79}=0,223), the results were confirmed with the non-parametric test (Z=-1,542, p=0,123). This way, there are no significant differences between the estimated volume and the actual volume of 40 centiliters to the volume of the glass.

Between the estimated volume of the liquid (Mean=32,89 centiliters, SD=19,53) and the actual volume of 30 centiliters, there are also no significant differences, using the one sample T-Test (t_{78}=1,316, p=0,192), again the assumption of normal distribution is not verified (for the estimated volume of the liquid K-S_{79}=0,217, p<0,001), the results were confirmed with the non-parametric test (Z=-0,957, p=0,339). There are also no significant differences between the estimated volume of the liquid and the actual volumes of 30 centiliters.

The estimated volume of liquid intake (Mean=13,63 centiliters, SD=12,12) and the actual volume of liquid intake (Mean=13,10 centiliters, SD=6,9) show no significant differences, using the paired samples t test (t_{78}=0,406, p=0,686), the assumption of normal distribution is again not verified (for the estimated volume intake K-S_{79}=0,103, p=0,037; for the actual volume of liquid intake: K-S_{79}=0,164, p<0,001), the results were confirmed with the non-parametric test (Z=-0,187, p=0,852). There are no significant differences between the estimated volume of the liquid intake and the actual volumes of liquid intake.

a) Relation between the estimated volume of a glass and the actual volume of 40 centiliters.

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Estimated volume of the glass (cl)	79	39.785	21.9175	2.4659

One-Sample Test

	Test Value = 40					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Estimated volume of the glass (cl)	-.087	78	.931	-.2152	-5.124	4.694

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Estimated volume of the glass (cl)	.223	79	.000	.579	79	.000
Estimated volume of the liquid (cl)	.217	79	.000	.548	79	.000

a. Lilliefors Significance Correction

Test Statistics[b]

	40 - Estimated volume of the glass (cl)
Z	-1.542[a]
Asymp. Sig. (2-tailed)	.123

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

b) Relation between the estimated volume of the liquid and the actual volume of 30 centiliters.

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Estimated volume of the liquid (cl)	79	32.892	19.5321	2.1975

One-Sample Test

	Test Value = 30					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Estimated volume of the liquid (cl)	1.316	78	.192	2.8924	-1.483	7.267

Test Statistics[b]

	30 - Estimated volume of the liquid (cl)
Z	-.957[a]
Asymp. Sig. (2-tailed)	.339

a. Based on positive ranks.

b. Wilcoxon Signed Ranks Test

c) Relation between the estimated volume of liquid intake and the actual volume of liquid intake.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Estimated volume of liquid intake (cl)	13.627	79	12.1229	1.3639
	Volume of liquid intaked (cl)	13.101	79	6.9275	.7794

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Estimated volume of liquid intake (cl) - Volume of liquid intaked (cl)	.5253	11.4977	1.2936	-2.0500	3.1007	.406	78	.686

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Estimated volume of liquid intake (cl)	.164	79	.000	.723	79	.000
Volume of liquid intaked (cl)	.103	79	.037	.961	79	.017

a. Lilliefors Significance Correction

Test Statistics[b]

	Volume of liquid intaked (cl) - Estimated volume of liquid intake (cl)
Z	-.187[a]
Asymp. Sig. (2-tailed)	.852

a. Based on positive ranks.

b. Wilcoxon Signed Ranks Test

Appendix 3

a) Relation between the estimated volume of the glass and the volume of liquid leftover.

Correlations

		Estimated volume of the glass (cl)	Volume of liquid leftover (cl)
Estimated volume of the glass (cl)	Pearson Correlation	1	.065
	Sig. (2-tailed)		.568
	N	79	79
Volume of liquid leftover (cl)	Pearson Correlation	.065	1
	Sig. (2-tailed)	.568	
	N	79	79

Correlations

			Estimated volume of the glass (cl)	Volume of liquid leftover (cl)
Spearman's rho	Estimated volume of the glass (cl)	Correlation Coefficient	1.000	.139
		Sig. (2-tailed)	.	.221
		N	79	79
	Volume of liquid leftover (cl)	Correlation Coefficient	.139	1.000
		Sig. (2-tailed)	.221	.
		N	79	79

Appendix 4

a) Relation between the estimated volume of the liquid and the color of the glass.

Group Statistics

	Color	N	Mean	Std. Deviation	Std. Error Mean
Estimated volume of the liquid (cl)	Light	40	31.750	9.2950	1.4697
	Dark	39	34.064	26.2989	4.2112

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Estimated volume of the liquid (cl)	Equal variances assumed	2.930	.091	-.524	77	.602	-2.3141	4.4160	-11.1075	6.4793
	Equal variances not assumed			-.519	47.139	.606	-2.3141	4.4603	-11.2863	6.6581

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Color	Statistic	df	Sig.	Statistic	df	Sig.
Estimated volume of the liquid (cl)	Light	.113	40	.200*	.960	40	.172
	Dark	.287	39	.000	.524	39	.000

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Test Statistics[a]

	Estimated volume of the liquid (cl)
Mann-Whitney U	744.500
Wilcoxon W	1524.500
Z	-.349
Asymp. Sig. (2-tailed)	.727

a. Grouping Variable: Color

Appendix 5

a) Relation between the estimated volume of the liquid and the size of the glass.

Group Statistics

	Size	N	Mean	Std. Deviation	Std. Error Mean
Estimated volume of the liquid (cl)	Short	40	24.213	6.8434	1.0820
	Tall	39	41.795	23.9662	3.8377

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Estimated volume of the liquid (cl)	Equal variances assumed	1.270	.263	-4.458	77	.000	-17.5824	3.9441	-25.4361	-9.7287
	Equal variances not assumed			-4.410	44.011	.000	-17.5824	3.9873	-25.6182	-9.5466

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Size	Statistic	df	Sig.	Statistic	df	Sig.
Estimated volume of the liquid (cl)	Short	.156	40	.016	.954	40	.103
	Tall	.344	39	.000	.426	39	.000

a. Lilliefors Significance Correction

Test Statistics[a]

	Estimated volume of the liquid (cl)
Mann-Whitney U	134.500
Wilcoxon W	954.500
Z	-6.350
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Size

Appendix 6

a) Relation of the interaction between color and size on the estimated volume of the liquid.

Univariate general linear model:

Between-Subjects Factors

		Value Label	N
Color	0	Light	40
	1	Dark	39
Size	0	Short	40
	1	Tall	39

Descriptive Statistics

Dependent Variable: Estimated volume of the liquid (cl)

Color	Size	Mean	Std. Deviation	N
Light	Short	26.450	6.6449	20
	Tall	37.050	8.6052	20
	Total	31.750	9.2950	40
Dark	Short	21.975	6.4369	20
	Tall	46.789	32.9099	19
	Total	34.064	26.2989	39
Total	Short	24.213	6.8434	40
	Tall	41.795	23.9662	39
	Total	32.892	19.5321	79

Tests of Between-Subjects Effects

Dependent Variable: Estimated volume of the liquid (cl)

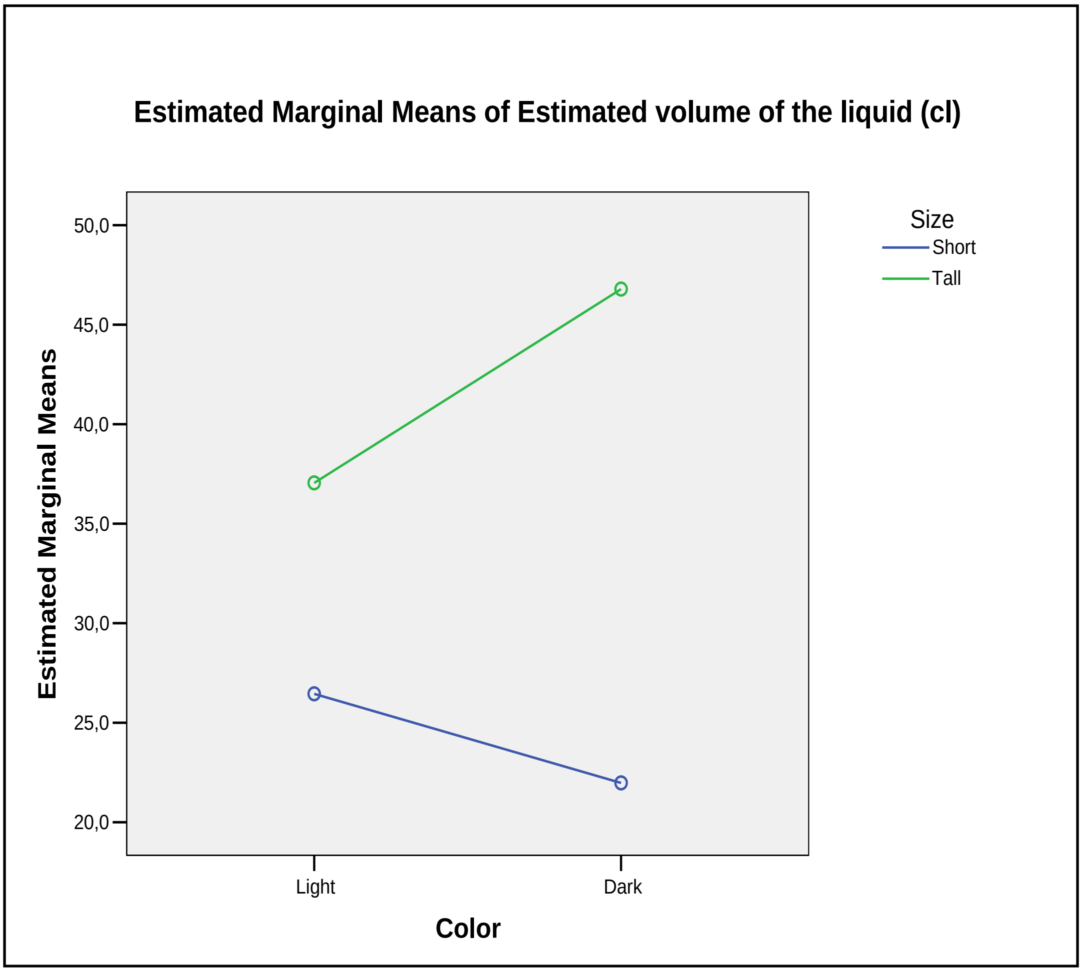
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7229.040[a]	3	2409.680	8.022	.000	.243
Intercept	86333.488	1	86333.488	287.417	.000	.793
color	136.774	1	136.774	.455	.502	.006
size	6189.484	1	6189.484	20.606	.000	.216
color * size	997.136	1	997.136	3.320	.072	.042
Error	22528.295	75	300.377			
Total	115228.250	79				
Corrected Total	29757.335	78				

a. R Squared = .243 (Adjusted R Squared = .213)

Color * Size

Dependent Variable: Estimated volume of the liquid (cl)

Color	Size	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Light	Short	26.450	3.875	18.730	34.170
	Tall	37.050	3.875	29.330	44.770
Dark	Short	21.975	3.875	14.255	29.695
	Tall	46.789	3.976	38.869	54.710



Multivariate General Linear Model:

Descriptive Statistics

	Color	Size	Mean	Std. Deviation	N
Estimated volume of the liquid (cl)	Light	Short	26.450	6.6449	20
		Tall	37.050	8.6052	20
		Total	31.750	9.2950	40
	Dark	Short	21.975	6.4369	20
		Tall	46.789	32.9099	19
		Total	34.064	26.2989	39
	Total	Short	24.213	6.8434	40
		Tall	41.795	23.9662	39
		Total	32.892	19.5321	79
Estimated volume of the glass (cl)	Light	Short	31.350	6.1753	20
		Tall	46.950	10.5155	20
		Total	39.150	11.6124	40
	Dark	Short	26.000	7.3771	20
		Tall	55.632	35.4247	19
		Total	40.436	29.0995	39
	Total	Short	28.675	7.2409	40
		Tall	51.179	25.8659	39
		Total	39.785	21.9175	79

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.857	221.603[a]	2.000	74.000	.000	.857
	Wilks' Lambda	.143	221.603[a]	2.000	74.000	.000	.857
	Hotelling's Trace	5.989	221.603[a]	2.000	74.000	.000	.857
	Roy's Largest Root	5.989	221.603[a]	2.000	74.000	.000	.857
color	Pillai's Trace	.036	1.398[a]	2.000	74.000	.254	.036
	Wilks' Lambda	.964	1.398[a]	2.000	74.000	.254	.036
	Hotelling's Trace	.038	1.398[a]	2.000	74.000	.254	.036
	Roy's Largest Root	.038	1.398[a]	2.000	74.000	.254	.036
size	Pillai's Trace	.380	22.658[a]	2.000	74.000	.000	.380
	Wilks' Lambda	.620	22.658[a]	2.000	74.000	.000	.380
	Hotelling's Trace	.612	22.658[a]	2.000	74.000	.000	.380
	Roy's Largest Root	.612	22.658[a]	2.000	74.000	.000	.380
color * size	Pillai's Trace	.049	1.926[a]	2.000	74.000	.153	.049
	Wilks' Lambda	.951	1.926[a]	2.000	74.000	.153	.049
	Hotelling's Trace	.052	1.926[a]	2.000	74.000	.153	.049
	Roy's Largest Root	.052	1.926[a]	2.000	74.000	.153	.049

a. Exact statistic

b. Design: Intercept+color+size+color * size

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Estimated volume of the liquid (cl)	7229.040[a]	3	2409.680	8.022	.000	.243
	Estimated volume of the glass (cl)	11021.421[b]	3	3673.807	10.418	.000	.294
Intercept	Estimated volume of the liquid (cl)	86333.488	1	86333.488	287.417	.000	.793
	Estimated volume of the glass (cl)	126229.633	1	126229.633	357.957	.000	.827
color	Estimated volume of the liquid (cl)	136.774	1	136.774	.455	.502	.006
	Estimated volume of the glass (cl)	54.776	1	54.776	.155	.695	.002
size	Estimated volume of the liquid (cl)	6189.484	1	6189.484	20.606	.000	.216
	Estimated volume of the glass (cl)	10096.628	1	10096.628	28.632	.000	.276
color * size	Estimated volume of the liquid (cl)	997.136	1	997.136	3.320	.072	.042
	Estimated volume of the glass (cl)	971.641	1	971.641	2.755	.101	.035
Error	Estimated volume of the liquid (cl)	22528.295	75	300.377			
	Estimated volume of the glass (cl)	26447.921	75	352.639			
Total	Estimated volume of the liquid (cl)	115228.250	79				
	Estimated volume of the glass (cl)	162513.000	79				
Corrected Total	Estimated volume of the liquid (cl)	29757.335	78				
	Estimated volume of the glass (cl)	37469.342	78				

a. R Squared = .243 (Adjusted R Squared = .213)

b. R Squared = .294 (Adjusted R Squared = .266)