Dietary Restraint and Hedonic Drivers of Sugar Sweetened Beverage Consumption

By

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ABSTRACT

Lily Jewel Jones; Dietary Restraint and Hedonic Drivers of Sugar Sweetened Beverage Consumption
(Under the direction of Kyle Burger)

Obesity is a major public health challenge that has been associated in part with increased sugar sweetened beverage consumption. Though caloric restriction has the potential to reduce the prevalence of obesity, high levels of dietary restraint have been linked to disordered eating and weight gain. This study examined the relationship between self-reported dietary restraint and the hedonic evaluation and consumption of sugar sweetened beverages. We expected a negative relationship between self-reported dietary restraint and consumption; however, though individuals with high restraint reported consuming fewer sugar sweetened beverages, dietary restraint was not associated with ad libitum intake. Further, upon tasting sugar sweetened beverages restrained eaters reported similar pleasure ratings to those with lower levels of eating restraint but expressed a decreased desire to consume. Implications and directions for future research are discussed.
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CHAPTER 1: STUDY AIMS AND HYPOTHESES

Obesity has become a major public health concern in the United States, as over 60% of the population is currently overweight or obese (Wyatt, Winters, & Dubbert, 2006). Theoretically, dietary restraint, the deliberate restriction of caloric intake for the purpose of weight loss or weight maintenance (Herman, 1975), has the potential to reduce the prevalence of obesity. However, many studies have failed to show a significant association between dietary restraint scales and caloric intake, while high self-reported dietary restraint has been linked to increased BMI (Snoek, van Strien, Janssens, & Engels, 2008; Stice, Sysko, Roberto, & Allison, 2010). Coinciding with the rise of obesity, soft drink consumption has dramatically risen in recent decades (Harnack, Stang, & Story, 1999; Reedy & Krebs-Smith, 2010). Increased sugar sweetened beverage intake has been epidemiologically and experimentally linked to weight gain, as well as poor diet quality and morbidity (Brownell et al., 2009; Malik, Schulze, & Hu, 2006). While the relation between dietary restraint and food consumption is relatively well studied, little is known about the role self-reported restraint plays in influencing sugar sweetened beverage intake. Therefore, we will examine how dietary restraint affects hedonic ratings and consumption of novel sugar sweetened beverages in 78 individuals.
Aim 1: To test the relationship between self-reported dietary restraint and sugar sweetened beverage consumption. We hypothesize that dietary restraint will be inversely related to sugar sweetened beverage consumption.

Aim 2: To examine the association between self-reported dietary restraint and hedonic ratings of beverages. We hypothesize that dietary restraint will be positively correlated with reported desire to consume sugar sweetened beverages.
CHAPTER 2: INTRODUCTION

Obesity is one of the most pressing issues currently facing public health in the United States, as more than 1 in 3 American adults are classified as obese (Ogden, Carroll, Kit, & Flegal, 2014). Out of the top 10 causes of mortality in the United States, 5 are related to obesity, including heart disease, stroke, diabetes, kidney disease and some cancers (Schmitz et al., 2013). Dietary restraint, the deliberate restriction of caloric intake for the purpose of weight loss or weight maintenance (Herman, 1975), has become a widespread method of weight control (Kruger, Galuska, Serdula, & Jones, 2004). However, many studies have failed to show a significant association between dietary restraint scales and caloric intake (Stice et al., 2010). Further, high dietary restraint has been linked to prospective weight gain and eating pathology (Snoek et al., 2008; van Strien, Herman, & Verheijden, 2014). Individuals with high and low reported eating restraint typically do not differ on palatability ratings of food, but there is mixed evidence regarding restrained individuals’ implicit attitudes towards food and how these attitudes may drive consumption (Papies, Stroebe, & Aarts, 2009; Roefs, Herman, MacLeod, Smulders, & Jansen, 2005).

In contrast to studies focusing on foods, researchers have observed significant differences in beverage consumption based on dietary restraint status (Elfhag, Tynelius, & Rasmussen, 2007; Olea López & Johnson, 2016). Coinciding with the rise of obesity, sugar sweetened beverage consumption has increased dramatically in recent decades.
Increased sugar sweetened beverage intake has been epidemiologically and experimentally linked to weight gain, as well as poor diet quality and morbidity (Brownell et al., 2009; Malik et al., 2006). Despite the wealth of research that has accumulated concerning restrained eating, little is known about the relationship between dietary restraint and sugar sweetened beverage consumption.

Lower dietary restraint has been associated with higher levels of sugar sweetened beverage consumption, while consumption of light soft drinks has been associated with higher restraint as well as increased BMI, kg/m$^2$ (Elfhag et al., 2007). Data from the National Diet and Nutrition Survey (NDNS) in the UK showed that higher restrained eating was associated with fewer kilocalories from beverages but not with drink frequency, again suggesting that restrained eaters may chosen lower-calorie diet drinks over SSBs (Olea López & Johnson, 2016). Restrained eaters may be more likely to consume diet drinks with the intention of caloric restriction; however, in females with eating restraint, substituting sugar sweetened beverages with diet drinks does not reduce total energy intake and may even result in a higher intake during the following day (Lavin, French, & Read, 1997).

Hedonic hunger describes the drive to eat to obtain pleasure in the absence of an energy deficit (Witt & Lowe, 2014). It is comprised of two main aspects: liking, or the pleasure we get from consuming food, and wanting, which is the drive or motivation to consume (Berridge, 2009). Individuals with higher eating restraint do not show an increased preference for palatable foods (Papies et al., 2009; Roefs et al., 2005). However, they may experience more cravings for these foods, and consume more as a
result (Coelho, Nederkoorn, & Jansen, 2014; Polivy, Coleman, & Herman, 2005). There is still much to learn about whether dietary restraint influences hedonic ratings of food and beverage, and how these ratings translate to patterns of consumption.

2.1 Dietary Restraint

Dietary restraint is defined as an individual’s intention to consume less than desired. High levels of dietary restraint have been linked to the development of eating disorders (Delinsky & Wilson, 2008; Katherine Schaumberg & Anderson, 2016). Specifically, one longitudinal study found that the relative risk of developing eating disorders for those who diet was 8 times that of those who did not diet (Patton, Johnson-Sabine, Wood, Mann, & Wakeling, 1990). Dietary restraint is also associated with obesity, as high restraint scores have been shown to predict an increase in BMI among women (van Strien et al., 2014). However, high BMI has also been shown to predict restrained eating behavior, rendering the temporality of the relationship unclear (Forrester-Knauss, Perren, & Alsaker, 2012; Snoek et al., 2008).

Various theories have been proposed to explain this relationship between dietary restraint, eating pathology and obesity. Initially, researchers proposed the theory of counterregulatory eating based on a study that found individuals with high dietary restraint were more likely to increase consumption following a pre-load intake (Herman, 1975). These authors suggested that once a restrained eater consumed food that was inconsistent with their restrained eating goals, they would enter into a disinhibited state and continue to over-consume. This theory provided evidence for the link found between high restraint and binge eating pathology (K. Schaumberg, Anderson, Anderson, Reilly, & Gorrell, 2016). In addition to the counterregulatory hypothesis, effective restriction of
intake is associated with biological changes that may promote weight regain, such as a slower metabolism, increased ghrelin levels and decreased leptin levels (K. Schaumberg et al., 2016). Finally, a cognitive mechanism that may help to explain the association between dietary restraint and weight gain is perceived deprivation. This concept suggests that restrained eaters may feel deprived when restricting themselves from consuming as much as they desire, but that this restriction may not result in a caloric deficit (Markowitz, Butryn, & Lowe, 2008). Perceived deprivation has found support in studies that have shown that restrained eaters instructed to “diet as usual” do not lose weight, while those who were to eat as if they were not dieting gained weight (Presnell, Stice, & Tristan, 2008).

There is mixed evidence with regard to how restrained eaters feel about highly palatable food. Studies measuring implicit attitudes have found that individuals with high dietary restraint show stronger implicit preferences for palatable food (Hoefling & Strack, 2008; Houben, Roefs, & Jansen, 2010). In contrast, other studies have shown that while unrestrained eaters evaluate palatable foods more positively than neutral foods, restrained eaters do not (Papies et al., 2009). In addition, some studies found restrained eaters show stronger implicit evaluations of the negative aspects of palatable food, while others found high restraint to correlate with negative explicit but positive implicit attitudes toward these foods (Houben, Roefs, & Jansen, 2012; Papies et al., 2009).

2.2 Sugar Sweetened Beverage Consumption

Sugar-sweetened beverages (SSBs) are typically defined as any drink containing added sugar, including sodas, fruit drinks, sports drinks, energy drinks, and sweetened iced tea. Compared to 30 years ago, American children and adults are consuming twice as
many calories from SSBs (Long et al., 2015). On a given day, 63% of adults report consuming at least one SSB, contributing an average of 7-13% total daily calories (Bleich, Wang, Wang, & Gortmaker, 2009; Kit, Fakhouri, Park, Nielsen, & Ogden, 2013). Numerous studies have found strong evidence linking SSB intake to weight gain and obesity (Malik et al., 2006). In addition to directly relating to weight gain, there is evidence to suggest that as SSB consumption increases, consumption of more nutritious beverages such as milk and fruit juice decreases (Harnack et al., 1999). For example, in 1991, children age 2-18 consumed 11.7% of their total energy from milk and 6.5% from SSBs, whereas in 2006 only 7.1% of total energy came from milk while 8.5% came from SSBs (Reedy & Krebs-Smith, 2010). It is clear that understanding motivations to consume SSBs is important for managing the obesity epidemic in the US.

2.3 Summary

As the prevalence of obesity in the US has increased, many individuals have turned to restrained eating as a method of weight control (Santos, Sniehotta, Marques, Carraça, & Teixeira, 2017). However, studies have shown that high levels of dietary restraint may lead to weight gain and disordered eating. SSBs, which have been linked to weight gain and poor diet, now contribute a significant amount to the American diet. Therefore, it is important to understand the ways in which dietary restraint affects SSB consumption. To investigate this relationship, we will assess self-reported dietary restraint using the Dutch Restrained Eating Questionnaire (DRES) and measure SSB consumption through a Food Frequency Questionnaire (FFQ) and ad-libitum intake of a highly rated SSB. We will also study participants’ hedonic ratings of beverages on domains including sweetness, pleasure, and desirability. We will examine the relationship
between these measures of dietary restraint, SSB consumption, and hedonic ratings in a sample of 78 healthy weight, overweight and obese individuals. We hypothesize that dietary restraint will be negatively correlated with SSB consumption but positively correlated with reported desire to consume.
CHAPTER 3: METHODS

3.1 Participants

Seventy-eight undergraduate and graduate students (mean ± SD age: 22.4 ± 3.5 y, 25 men and 52 women) from a large, public university in North Carolina were recruited through fliers to participate in a taste test of fruit flavored beverages. Participants had a mean BMI of 23.7 ± 4.0 kg/m². The sample was 21% Asian, 15% black, 50% white, and 13% mixed race or other. Informed written consent was obtained before data collection; methods were approved by the University of North Carolina at Chapel Hill’s Institutional Review Board.

3.2 Preparation of flavored beverages

A total of 9 beverages were created, with a range of 3 novel flavors made from combining unsweetened Kool-Aid (black cherry orange, pink lemonade cherry, and strawberry kiwi lemonade). Each flavor was divided into 3 varying levels of sweetness: fully sweetened (100 mL sweetener/L), half-sweetened (50 mL sweetener/L) and unsweetened. Participants also tasted colored distilled water. Order of beverage consumption was randomized for each participant.

3.3 Procedure

Participants visited the lab for one 45-minute session. During the session, research assistants interacted with the participants and collected data on iPads. An overview of the study visit is shown in Figure 1.
3.4 Measures

3.4.1 Restrained eating

Restrained eating was measured using the Dutch Restrained Eating Scale (DRES). This questionnaire contains 10 items with a Likert response format ranging from 1 “never” to 5 “always” (sample item: Do you deliberately eat less in order not to become too heavy?). Scores range from 0-4, with higher scores indicating higher levels of restraint. The scale has shown internal consistency (α’s range from 0.93 to 0.95) and temporal reliability (2-week test-retest r=0.82) (Stice, Fisher, & Lowe, 2004).

3.4.2 Beverage Consumption

Sugar sweetened beverage consumption was measured using a Food Frequency Questionnaire (FFQ), in which participants were asked to report how often they had consumed various beverages in the past 2 weeks (Hu et al., 1999). Total sugar consumed was calculated based on average sugar of the beverages. In validations studies the FFQ showed similar results to dietician assessed diet history (Feunekes, Van Staveren, De Vries, Burema, & Hautvast, 1993). Consumption was also measured by assessing ad libitum intake of highest rated beverage following the taste test, with the beverage weight recorded pre- and post-consumption.

3.4.3 Hedonic and Internal State Ratings

Participants rated each beverage individually across 4 domains of sweetness, pleasantness, desirability, and intensity. Ratings were measured using a Visual Analog Scale (VAS) ranging from not at all (1) to extremely (10). Participants also rated their current state of hunger, fullness, and thirst on a VAS and provided the amount of time since their last meal to be examined as potential confounders.
3.4.4 Additional Measures

Body mass index (BMI; kg/m$^2$) was used as a measure of adiposity. Height was measured to the nearest millimeter using a stadiometer and weight was assessed to the nearest 0.1 kg using a digital scale. Non-fasted blood glucose was assessed using a finger prick and glucometer to be used as a covariate in analyses.

3.4.5 Analysis

Pearson’s correlations were used to assess aim 1 and aim 2. Correlations were also used to examine associations between continuous measures, for example, BMI and dietary restraint. Linear regression modeling was used to further investigate aim 2, as well as hedonic measures and ad libitum consumption, to account for covariates such as hunger. In addition, t-tests were used to examine differences in hedonic evaluations between the 3 levels of sweetness, for example, pleasantness ratings for fully sweetened and half sweetened beverage. For the ad libitum measures, 14 participants were excluded because their highest rated beverage was water (n=10), an unsweetened flavor (n=2) or no data was collected (n=2), so we lacked data on their ad libitum SSB consumption. All results were considered to be significant at a p<0.05 (two-tailed).
CHAPTER 4: RESULTS

4.1 Participant Characteristics

Within our sample, we observed a mean BMI of 23.7 ± 4.0 kg/m², with a range of 17.4 to 39.1 kg/m². The sample included 52 females and 26 males, with 21% Asian, 15% black, 50% white, and 13% mixed race or other. Seventy-two percent of these individuals were healthy weight (18.5 to 24.9 kg/m²), 28% were overweight (25 to 29.9 kg/m²) and 6% were obese (>30 kg/m²). Baseline characteristics for the study are summarized in Table 1.

The average score on the Dutch Restrained Eating Scale (DRES) was 2.28 ± 0.76, out of a possible range of 0 to 4. No significant difference was observed in DRES scores or BMI between males and females. Participants reported an average sugar intake of 15.3 ± 14.5 g/day from SSBs in the previous 2 weeks. The average ad libitum SSB intake was 69.8 ± 54.6 g during the study session.

4.2 Results

4.2.1 Dietary Restraint, Beverage Intake and BMI

BMI was shown to positively correlate with restrained eating (r=0.35, p=0.002; Figure 1), yet a negative correlation was observed between restrained eating and self-reported SSB intake (r=-.23, p=0.042; controlling for BMI). No significant relationship was observed between restrained eating and acute ad libitum intake, nor was there a correlation found between dietary restraint and self-reported consumption of soda or diet soda. Restraint status was unrelated to reported current hunger.
Acute ad libitum intake of the fully sweetened beverage negatively correlated with blood glucose ($r=-.35$, $p=0.005$), and positively correlated with time since last meal ($r=0.28$, $p=0.027$), and current hunger ($r=0.32$, $p=0.011$). Ad libitum beverage intake was also positively associated with ‘desire to consume’ that beverage ($r=0.37$, $p=0.003$; Figure 2); this effect remained when controlling for blood glucose, time since last meal, current hunger, and beverage flavor ($\beta=6.02$, $R^2=0.30$, $p=0.036$). Correlations are summarized in Table 2.

**4.2.2 Dietary Restraint and Hedonic Ratings**

Ratings for beverages are summarized in Table 3. Restrained eating was negatively related to ‘desire to consume’ the fully sweetened beverages ($r=-0.23$, $p=0.04$; Figure 3), and this effect held when controlling for average pleasantness ratings ($\beta=-0.450$, $R^2=0.73$, $p=0.01$). Hedonic ratings did not correlate with BMI or reported SSB intake. Further, there was no significant relationship between restrained eating and desire to consume unsweetened or half-sweetened beverages, nor with pleasantness or sweetness ratings across any of the sweetness levels.
CHAPTER 5: DISCUSSION

The purpose of this study was to determine how dietary restraint affects hedonic ratings and consumption of SSBs. We found BMI positively correlated with dietary restraint, which mirrors what has been seen in the literature (Forrester-Knauss et al., 2012; Snoek et al., 2008; van Strien et al., 2014). Of course, due to the cross-sectional nature of this study, we are unable to draw any conclusions regarding the temporality of this relationship. There was a slight negative association between self-reported total sugar consumed from SSB and dietary restraint. The finding that restrained eaters report consuming less SSBs than unrestrained eaters is similar to what was found by Goldstein and colleagues (Goldstein, Katterman, & Lowe, 2013). This relationship has been explained by the finding that restrained eaters are more likely to consume diet sodas compared to unrestrained eaters (Elfhag et al., 2007; Olea López & Johnson, 2016). However, we found no correlation between dietary restraint and self-reported diet soda consumption. This suggests that restrained eaters are not replacing SSBs with diet drinks, but rather with other unsweetened drink choices or no drinks at all. Further research would be necessary to determine if restrained eaters are replacing SSBs with another beverage, and, if so, what type of beverage.

Although restrained eaters reported consuming less SSBs than unrestrained eaters, we found no association between restrained eating and ad libitum intake of a highly rated SSB. This finding conflicts with results from the FFQ because it suggests that restrained
eaters will consume the same amount of SSB as unrestrained eaters. There are two possible explanations for this divergence. The first possibility is that the FFQ is not representative of actual intake in this sample, and that restrained eaters are underreporting their SSB consumption. Although the FFQ is a validated measure of assessing dietary consumption, high restraint has been associated with underreporting energy intake (Asbeck et al., 2002; Svendsen & Tonstad, 2006). The second explanation relates to the counterregulatory hypothesis; assuming the taste test acted as a preload, consuming the SSBs may have served to disinhibit the restrained eaters in a way that their typical diet does not. A twin study that examined the effect of a milkshake preload on restrained and unrestrained eaters’ consumption found the twins consumed similar amounts but the restrained twin had higher endogenous ghrelin levels (Myhre et al., 2014). To clarify this relationship, further research should compare consumption without a preload to intake following a preload and consider assessing hormone levels in restrained and unrestrained eaters.

In line with the perceived deprivation theory, we hypothesized that restrained eaters would report an increased desire to consume SSB but would actually consume less beverage. Interestingly, we found that high restraint correlated with a decreased desire to consume. Further, whereas desire to consume significantly predicted ad libitum intake of beverage for the general sample, we did not see a relationship between restraint and ad libitum consumption. These findings support the research that shows restrained eaters hold positive implicit but stronger negative explicit attitudes toward palatable foods compared to unrestrained eaters (Hoefling & Strack, 2008). Desire to consume half-sweetened and unsweetened beverages did not vary based on restraint status, which also
supports research showing restrained eaters only hold these dissociative feelings toward high calorie foods (Hoefling & Strack, 2008). Pleasantness ratings were also independent of dietary restraint, suggesting past researchers were correct in suggesting restrained eaters differ not in their preference for palatable foods, but in their cravings for these foods (Roefs et al., 2005). Research examining implicit attitudes held towards SSBs in individuals with eating restraint could further clarify this relationship.

Given the documented relationship between dietary restraint and disordered eating, a limitation of this study is that we did not screen individuals for eating disorders. This leaves us unable to analyze any potential correlation between reported restraint and disordered eating in this sample. In addition, we cannot assess whether ad libitum intake or self-reported consumption patterns may have been affected by an individual’s eating disorder. The presence of an eating disorder may have also affected individuals’ hedonic ratings of the beverages. Due to the confounding nature of eating disorders, future research should screen participants for eating disorders and consider excluding individuals with disordered eating from studies of this nature.

An additional limitation of this study was the fact that we could not include 18% of our study population in our assessment of ad libitum consumption because participants chose an unsweetened drink as their favorite beverage. This problem could have been avoided if instead of giving participants their overall favorite beverage, we had chosen to give them their highest ranked sweetened beverage. Though excluding the data of those participants did not significantly affect the results, the power of the study would have been improved if we had been able to use data from the full sample.
A final limitation of this study is the population from which we sampled. We focused our recruitment in the School of Public Health, where students typically hold more critical views of SSBs and sugar in general. Unfortunately we did not gather information on students’ program of study, prohibiting us from analyzing this as a confounder. Future research should consider assessing participants preexisting views of SSBs and broad opinions about nutrition in order to account for potential confounders.

In summary, our study adds to the existing body of research on restrained eating, and provides new insight into how high restraint affects hedonic evaluation and consumption of SSBs. Future research should continue to explore the disconnect between restrained eaters’ expressed desire to consume palatable beverages and their realistic consumption patterns, perhaps by exploring implicit attitudes towards SSBs. Other remaining areas of interest include clarifying the relationship between restrained eaters and diet soda consumption, as well as assessing how hormones such as ghrelin and leptin vary in regard to SSB consumption in individuals with high restraint.
APPENDIX A: DATA TABLES

Table 1. Baseline characteristics of participants (n=78).

<table>
<thead>
<tr>
<th></th>
<th>Male n=25</th>
<th>Female n=52</th>
<th>Total sample n=78</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>22.0 ± 3.7</td>
<td>22.5 ± 3.4</td>
<td>22.4 ± 3.5</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>24.3 ± 3.9</td>
<td>23.4 ± 4.1</td>
<td>23.7 ± 4.0</td>
</tr>
<tr>
<td>DRES (0-4)</td>
<td>2.16 ± 0.82</td>
<td>2.33 ± 0.73</td>
<td>2.27 ± 0.76</td>
</tr>
<tr>
<td>Hunger (1-10)</td>
<td>3.44 ± 2.33</td>
<td>3.12 ± 2.74</td>
<td>3.22 ± 2.60</td>
</tr>
<tr>
<td>Blood glucose (mg/dL)</td>
<td>98.0 ± 13.6</td>
<td>99.1 ± 13.8</td>
<td>98.7 ± 13.6</td>
</tr>
</tbody>
</table>

No significant differences were observed between genders.

Table 2. Pearson’s correlations between measures

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) BMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) DRES</td>
<td>0.35*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) FFQ</td>
<td>0.21</td>
<td>-0.23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) Ad Libitum</td>
<td>-0.94</td>
<td>-0.10</td>
<td>0.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5) Blood Glucose</td>
<td>0.01</td>
<td>0.001</td>
<td>-0.21</td>
<td>-0.35**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6) Hunger</td>
<td>-0.14</td>
<td>-0.09</td>
<td>0.01</td>
<td>0.32*</td>
<td>-0.41**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(7) Pleasantness (FS)</td>
<td>0.05</td>
<td>-0.10</td>
<td>0.01</td>
<td>0.34**</td>
<td>0.018</td>
<td>0.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(8) Desire to Consume (FS)</td>
<td>0.08</td>
<td>-0.23</td>
<td>0.13</td>
<td>0.37**</td>
<td>-0.08</td>
<td>0.12</td>
<td>0.85***</td>
<td></td>
</tr>
</tbody>
</table>

* p<0.05; ** p< 0.01; *** p<0.001
**Table 3. Hedonic ratings of beverages.**

<table>
<thead>
<tr>
<th></th>
<th>Unsweetened (US)</th>
<th>Half-sweetened (HS)</th>
<th>Fully-sweetened (FS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweetness***</td>
<td>1.82 ± 1.43</td>
<td>3.5 ± 1.98</td>
<td>5.78 ± 1.82</td>
</tr>
<tr>
<td>Pleasantness***</td>
<td>1.8 ± 1.53</td>
<td>3.42 ± 1.86</td>
<td>4.87 ± 2.06</td>
</tr>
<tr>
<td>Desire to Consume***</td>
<td>1.5 ± 1.5</td>
<td>2.83 ± 1.87</td>
<td>4.25 ± 2.27</td>
</tr>
<tr>
<td>Intensity</td>
<td>4.0 ± 1.9</td>
<td>4.86 ± 2.02</td>
<td>5.2 ± 2.0</td>
</tr>
</tbody>
</table>

***Differences between sweetness levels were significant at p<0.001
APPENDIX B: FIGURES

Figure 1. Timeline of study visit.

Figure 2. Scatterplot showing relationship between dietary restraint and BMI ($r=0.35$).
Figure 3. Scatterplot showing relationship between reported desire to consume SSB and ad libitum SSB consumed \((r=0.37)\).

Figure 4. Scatterplot showing relationship between dietary restraint and reported desire to consume SSB \((r=-0.23)\).
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