A Salient Sugar Tax Decreases Sugary Drink Buying

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Abstract

Many governments have introduced sugary drink excise taxes to reduce purchasing and consumption of such drinks; however, they do not typically stipulate how such taxes should be communicated at point-of-purchase. Historical, field, and experimental data entailing over 225,000 purchase decisions indicated that introducing a $0.01/ounce SSB tax—without making it salient on price tags—had no effect on purchasing (-1.26%; p=.28). However, when "Includes Sugary Drink Tax" was added to tax-inclusive price tags, SSB purchasing was lower than: pre-tax (-9.78%; p<. 001); a post-tax period when drinks did not bear price tags (-5.04%; p<.001); and a post-tax period when drinks bore tax-inclusive price tags that did not mention the tax (-3.83%, p=.002). Making the tax's beneficiary (student programs) salient on price tags had no added effect. Two follow-up experiments suggest that tax-salience was effective partly because consumers overestimate the tax amount, leading to reduced purchase intention.

Keywords: Decision-making, Health, Policy

Statement of Relevance

Consumption of SSBs, such as soda, is a leading contributor to serious health problems, including obesity, diabetes, and heart disease. Therefore, to reduce purchasing and consumption of such drinks, many governments have introduced SSB excise taxes. We show via a combination of historical, field, and experimental data entailing over 225,000 purchase decisions, that merely introducing a SSB tax—without making it salient on price tags—had no effect on purchasing (1.26% reduction; $p = .28$). However, when "Includes Sugary Drink Tax" was on price tags, SSB purchasing was lower than: pre-tax (-9.78%; $p < .001$); a post-tax period in which drinks did not bear price tags (-5.04%; $p < .001$); and a post-tax period in which drinks bore tax-inclusive price tags that did not mention the tax (-3.83%, $p = .002$). These results suggest that SSB taxes may be ineffective if they are not made salient directly on price tags.

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Consumption of SSBs has been linked to serious health problems including obesity (Malik, Pan, Willett, & Hu, 2013), diabetes (Imamura et al., 2015), and heart disease (Xi et al., 2015). To reduce purchasing and consumption of such drinks, governments have implemented SSB excise taxes—taxes levied on distributors and typically passed onto consumers, increasing the shelf price of SSBs relative to non-SSBs. By the end of 2020, 44 countries and seven U.S. cities had implemented such taxes—and in the U.S., this tax ranges from one to two cents per ounce (GFRP, 2020).

Evidence pointing to the effectiveness of these taxes (e.g., Lee et al., 2019; Roberto et al., 2019; Silver et al., 2017) has focused on comparing the presence versus absence of such a tax. Roberto et al. (2019) found SSB purchasing to be lower within versus outside of a taxed region; similarly, others have found SSB purchasing (Silver et al., 2017) and self-reported SSB consumption (Lee et al., 2019; Silver et al., 2017) to be lower post-tax introduction compared with pre-tax periods. Here, we focus on how such a tax is conveyed on shelf price tags, which currently varies considerably across retailers—not surprisingly, as firms have discretion in how they inform customers of the tax. In a recent evaluation of Philadelphia's tax for example (Roberto et al., 2019), some price tags conveyed that the price included a SSB tax (e.g., "$1.12, includes sugary drink tax"), while others made no mention of the tax. We surmise that the way such a tax is communicated at point of purchase can impact its capacity to decrease SSB purchasing.

We suggest that making an excise tax salient on price tags—noting that the price of the drink includes a SSB tax, without necessarily conveying the amount of that tax—can affect

buying. Research indicates that explicitly denoting that a price included an "unhealthy food surcharge" reduced buying of unhealthy items relative to the surcharge alone (Shah, Bettman, Ubel, Keller, & Edell, 2014). Interestingly, this prior work avoided the word "tax;" the price increase was conveyed using an equivalent, though arguably less charged, term "surcharge." Yet, given that at least in the United States, the word "tax" has negative connotations (Sussman & Olivola, 2011), price tags explicitly denoting that prices include a SSB tax might reduce buying—beyond the effect of the tax (i.e., price increase) itself. Consistent with this idea, and akin to how a "surcharge" may be less evocative than "tax," a "tax-free" promotion was more effective at spurring sales relative to when the equivalent savings were described as "discounts" (Sussman & Olivola, 2011).

Not only are consumers generally averse to taxes (Kessler & Norton, 2016), they particularly dislike paying taxes on hedonic items (e.g., alcohol, tobacco). In several states, taxes levied on hedonic products have been met with public opposition (Kotler, 2017) and industry contention, sparking political controversy (Jacobs, 2019). Emblematic of this opposition, Cook County, Illinois' commissioners voted 15 to 1 to repeal the county SSB tax just two months after it had been implemented (Dewey, 2017).[1] Perhaps as a result of the negative sentiment toward taxes, policy-makers have tried to make SSB taxes more palatable by highlighting their beneficiaries. Some have attributed Philadelphia's successful passing of its SSB excise tax to the fact that its proceeds were pledged to pre-K education (Purtle, Langellier, & Lê-Scherban, 2018). Similarly, Boulder and Seattle dedicated tax proceeds to social programs (City of Boulder, 2016;

[1] Granted, this tax was unlike other U.S. SSB taxes because it was levied directly on consumers rather than distributors (i.e., it was a general consumption tax as opposed to an excise tax). As such it was applied at the register rather than reflected in the shelf price—a factor that could have contributed to its unpopularity.

City of Seattle, 2017). Therefore, in addition to testing whether tax-salient price tags decrease SSB purchasing, we also test the effect of adding the tax's beneficiary to such tags.

Overview of Studies

Study 1 was a field study in which we tested whether making a SSB tax salient decreased purchasing of such drinks. The study employed an eight-week sequential design which began with a control condition in which drinks simply bore tax-inclusive price tags. Next came a period in which we made the tax salient by adding the phrase "Includes SF Sugary Drink Tax" to the price tags. In the final period, we added mention of the tax's beneficiary (in this case student programs) to the price tags. To contextualize the effects of our intervention, we also obtained historical sales data from two periods that preceded the intervention—one pre-tax and one post-tax. Next, we conducted two online experiments. Study 2 tested whether a tax-salient price tag might reduce SSB purchasing because people tend to overestimate the tax amount. Study 3 provides a conceptual replication of Study 1 and convergent evidence of underlying process.

Study 1: Field Study

Methods

Setting. The study took place in two convenience stores on a university campus in San Francisco where a $0.01 per ounce SSB excise tax had been implemented on January 1, 2018. At that time, the university had 29,586 students (47.03% female, 17.36% white). In accordance with the SSB excise tax policy, vendors paid this tax on all SSB sales and could pass it onto customers in commensurate price increases. Both of our field sites elected to do so, as is

common (Roberto et al., 2019). From January 1, 2018 through the study period, in-store posters informed patrons of the tax (See Supplement Figure S2).

The study was conducted over an eight-week period (September - November 2018) on weekdays (the stores were closed on weekends). We pre-specified this time period based on a power analysis informed by historical sales data (from September-November, 2017—matched calendar weeks from the year prior) with the parameters: 95% power ($\beta = 0.05$), Type I error rate of 5% ($\alpha = 0.05$), a small effect (Cohen's d = .20), and assuming a Fisher's Exact statistical test.

Treatment. We varied the price tags placed on SSBs and measured SSB buying. We tested three different versions of SSB price tags (described below); price tags on non-SSBs were held constant throughout the study period (these simply stated the price, which of course did not include a SSB tax). We defined SSBs per the San Francisco sugary drink ordinance (Proposition V) that was in effect during the study, which considered SSBs as drinks that have 25 or more calories per 12 ounces, excluding milk and 100% fruit juice. All price tags were 3.5 x 1-inches in size and hung directly underneath each drink. See Supplement (Figure S3) for a photograph of one of the store's refrigerators, depicting the drinks with price tags on them.

In the control condition, the price tags only stated the SSB tax-inclusive price. Two sequential treatments tested the impact of additional text placed on the price tags. In the tax-salient condition, the text "*Includes SF Sugary Drink Tax*" was added (SF = "San Francisco"). In the recipient-salient condition, the price tag also conveyed who would receive the proceeds of the tax; specifically, the text: "*[Name of store] matches and donates proceeds to [University] student programs*" was further added.[2] The recipient-salient condition offered a test of whether it is wise to indicate a (benevolent) beneficiary of the tax, as was done in Philadelphia. Thus, we

[2] After the study and on behalf of the store, we matched all tax proceeds from the recipient-salient condition and donated it to student programs. This resulted in a donation of $2,066.76.

chose a beneficiary – student programs – that we assumed was likely to resonate with patrons, as most patrons were students. And, because this tag was slightly more complex than the others, we pretested it to ensure it was comprehensible. This pre-test (N = 450; see Supplement Table S1) demonstrated that 93.2% of respondents correctly indicated the imposer of the tax (San Francisco) and its beneficiary (student programs).

Each price tag was tested for a two-week period. The price tags are depicted in Table 1 and the study timeline is depicted in Table 2. To prevent possible spillover effects, both the tax-salient and recipient-salient conditions were followed by a 1-week washout period, during which we reverted to the control tags (cf., Bleich, Barry, Gary-Webb, & Herring, 2014; Donnelly, Zatz, Svirsky, & John, 2018).

Table 1. Price Tags Used for SSBs and Non-SSBs

	SSBs	Non-SSBs
Control	$1.52	$1.40
Tax-Salient	$1.52 **Includes SF Sugary Drink Tax**	$1.40
Recipient-Salient	$1.52 **Includes SF Sugary Drink Tax** **[Store] matches and donates proceeds to [university] student programs**	$1.40

Note. The above tags reflect the price of a 12-ounce drink at the time of the study.

Historical data. Prior to our study, drinks did not bear price tags. Thus, our control condition, whereby we placed tax-inclusive price tags on drinks, could itself be considered an intervention because it made the prices—including the price difference between an SSB (e.g.,

Coke) and its non-SSB equivalent (e.g., Diet Coke)—salient. Therefore, we obtained sales data from the two weeks immediately preceding the study period. During this baseline period, the SSB tax was in effect, but there were no price tags on any drinks. We also obtained sales data from 2016 and 2017—the two years preceding the SSB tax. These data enabled us to disentangle the effect of making a tax salient from that of the tax itself. And, as described in our analysis plan, the historical data also helped us to ensure that observed effects of our intervention were not simply a byproduct of cyclical weekly changes in drinking habits that happened to coincide with our treatment.

Table 2. Timeline of Study 1

<table>
<tr><td></td><td colspan="4">September</td><td colspan="4">October</td><td colspan="2">November</td></tr>
<tr><td></td><td>Week 1</td><td>Week 2</td><td>Week 3</td><td>Week 4</td><td>Week 1</td><td>Week 2</td><td>Week 3</td><td>Week 4</td><td>Week 1</td><td>Week 2</td></tr>
<tr><td>2016</td><td colspan="2" rowspan="2">Pre-tax control for Baseline period</td><td colspan="2" rowspan="2">Pre-tax control for Control condition</td><td colspan="2" rowspan="2">Pre-tax control for Price-salient condition</td><td rowspan="2"></td><td colspan="2" rowspan="2">Pre-tax control for Recipient-salient condition</td><td rowspan="2"></td></tr>
<tr><td>2017</td></tr>
<tr><td>2018</td><td colspan="2">Baseline</td><td colspan="2">Control</td><td colspan="2">Price-salient</td><td>Washout</td><td colspan="2">Recipient-salient</td><td>Washout</td></tr>
</table>

Note. Grey shading denotes study period.Throughout the entire study period, a $0.01/ounce sugary drink tax was in effect, and all drinks bore tax-inclusive price tags.

Outcome measures. Our primary interest was whether the information on price tags shifted consumers away from buying SSBs. Therefore, our primary outcome measure was the proportion of SSBs bought (i.e., number of SSB units purchased / number of drink units purchased; c.f., Donnelly et al., 2018; VanEpps et al., 2016; Bleich, Herring, Flagg, & Gary-Webb, 2012). For secondary outcomes, we assessed absolute changes in drink sales, drink calories sold, and share of bottled water bought.

Analysis plan. For our primary analysis, we conducted Fisher's exact tests to compare the proportion of SSBs bought as a function of the different periods (c.f., Donnelly et al., 2018).

Pairwise comparisons of SSB purchasing between periods allowed us to address the following questions, which we report in order in the results section: (1) does the tax itself impact purchasing? (pre-tax versus baseline); (2) does adding tax-inclusive price tags impact purchasing? (baseline versus control); (3) does tax-salient price tags impact purchasing? (control versus tax-salient; our focal comparison); and (4) does making the beneficiary of the tax salient further impact purchasing? (tax-salient versus recipient-salient).

Given that calendar week confounds are possible in sequential designs, we also compared SSB sales during each 2018 period (baseline, control, tax-salient, recipient-salient) to its matched calendar week from each of the two years prior to the instatement of the tax (i.e., 2016 and 2017). To facilitate this analysis, we first ascertained that there was no difference in the share of SSBs bought in 2016 relative to 2017 (p = .92, d = .00, 95% CI: -.03, .03, comparing the baseline matched weeks; p = .78, d = .00, 95% CI: -.02, .03, comparing the control matched weeks; p = .12, d = .02, 95% CI: -.01, .05, comparing the tax-salient matched weeks; and p = .54, d = .01, 95% CI: -.02, .04, comparing the recipient-salient matched weeks). Therefore, we collapsed across 2016 and 2017, treating these years as a "pre-tax" period to compare matched pre-tax period calendar weeks with (1) the baseline weeks and (2) each condition. The mapping of the 2018 period to the pre-tax periods is depicted in the study timeline (Table 2).

In supplementary analyses, we also considered the possible effects of temperature and humidity. Note that weather affects the volume of drinks sold but is less likely to affect the mix of drinks sold (i.e., whether people buy SSBs versus non-SSBs; see Donnelly et al., 2018). Nonetheless, we conducted a multivariable linear regression in which the dependent variable was the proportion of SSBs purchased, with dichotomous independent variables for each of the three price tag interventions. The omitted category in the regression was the baseline period, so

coefficients on each of the dichotomous independent variables indicated differences relative to baseline. We also included independent variables indicating the daily average temperature and daily average humidity. We ran the same regression predicting the average calories per drink bought. To assess possible substitution effects—whether reduced SSB buying might have been offset by a corresponding increase in water buying—we conducted Fisher's exact tests to assess the proportion of bottled water bought by condition. We also conducted Fisher's exact tests to draw comparisons of the proportion of SSBs purchased as a function of the price tag intervention from historical data.

The study was pre-registered: http://aspredicted.org/blind.php?x=mz6a9t. Stimuli and data for this and subsequent studies are posted: https://bit.ly/2vTGgbz.

Results

Descriptives. Across the study period, an average of 7,582 (*SD* = 681.67) drinks were bought weekly (*NS* between weeks), 45.5% (*SD* = 1.2%) of which were SSBs (Table 3).

Table 3. SSB purchases during the intervention period (2018) and pre-tax comparison periods (2016, 2017)

	2018 (Study Period)		**2017 (Pre-tax)**		**2016 (Pre-tax)**	
	Total Drinks Bought	**SSBs Bought (% of total)**	**Total Drinks Bought**	**SSBs Bought (% of total)**	**Total Drinks Bought**	**SSBs Bought (% of total)**
Baseline	13,752	6,549 (47.6%)	15,392	7,466 (48.5%)	13,468	6,524 (48.4%)
Control	15,188	7,136 (47.0%)	17,144	8,444 (49.3%)	14,973	7,351 (49.1%)
Tax-Salient	16,073	7,263 (45.2%)	14,537	7,346 (50.5%)	14,992	7,438 (49.6%)
Washout	8,174	3,784 (46.3%)	7,751	3,984 (51.4%)	7,589	3,773 (49.7%)

Recipient-Salient	14,852	6,615 (44.5%)	16,435	8,312 (50.6%)	13,937	6,999 (50.2%)
Washout	7,786	3,463 (44.5%)	6,580	3,389 (51.5%)	6,828	3,391 (49.7%)

Note. The SSB tax was introduced on January 1, 2018. Therefore, data from 2016 and 2017 were pre-tax.

Share of SSBs bought. The proportion of SSBs bought, by period, is plotted in Figure 1. The number of SSBs bought, by period, is listed in Table 3. As described in the analysis plan, we first assessed whether fewer SSBs were bought after the tax had been introduced. The share of SSBs bought in the baseline period was not different from that of the pre-tax period matched calendar weeks from 2016 and 2017 (a 1.79% reduction, $p = .10$, $d = .02$, 95% CI: -.01, .05; Figure 1, first pair of bars). In other words, the tax itself did not correspond to a decrease in SSB purchasing.

Second, we assessed the effect of introducing tax-inclusive price tags. The share of SSBs bought in the control condition (47.0%), wherein drinks bore tax-inclusive price tags, was not different from the two-week baseline period immediately preceding it (47.6%; a 1.26% reduction, $p = .28$, $d = .01$, 95% CI: -.01, .04), during which drinks did not bear price tags. However, the share of SSBs bought in the control condition was lower relative to its matched pre-tax period calendar weeks (47.0% versus 49.2%; a 4.47% reduction; $p < .001$, $d = .05$, 95% CI: .03, .08; Figure 1, second pair of bars).

Third, we assessed our question of primary interest: whether tax-salient price tags decreased purchasing. The share of SSBs bought in the tax-salient condition (45.2%) was lower than both the baseline period (47.6%; a 5.04% reduction, $p < .001$, $d = .06$, 95% CI: .03, .09) and the control condition (47.0%; a 3.83% reduction, $p = .002$, $d = .02$, 95% CI: .01, .04)—differences that also translated into significantly fewer drink calories bought ($M_{\text{tax-salient}} = 96.45$ calories, $SD = 101.55$ versus $M_{\text{baseline}} = 105.83$ calories, $SD = 104.65$, $p < .001$, $d = .09$, 95% CI:

.07, .11; versus $M_{control}$= 102.97 calories, *SD* = 104.23: $p < .001$, $d = .06$, 95% CI: .04, .09; Figure S1). These effects are robust to daily heat index, daily humidity, and store (Table 4 & Supplement Table S2). Moreover, the share of SSBs bought in the tax-salient condition was also lower relative to its matched pre-tax period calendar weeks (45.2% versus 50.1%; a 9.80% reduction; $p < .001$, $d = .12$, 95% CI: .09, .14; Figure 1, third pair of bars).

Fourth, we assessed whether making the beneficiary of the tax salient further impacted purchasing. The share of SSBs bought during the recipient-salient condition (44.5%) was not statistically different from the tax-salient condition (a 1.15% reduction, $p = .243$, $d = .018$, 95% CI: -.01, .05); the average calories purchased was also equivalent ($M_{recipient\text{-}salient}$ = 94.85 calories, *SD* = 101.31 versus $M_{tax\text{-}salient}$ = 96.45 calories, *SD* = 101.55, $p = .17$, $d = .01$, 95% CI: -.01, .04). These results suggest that noting the tax's beneficiary does not affect SSB buying beyond making the tax salient. The share of SSBs bought in the recipient-salient condition was also lower relative to its matched pre-tax period calendar weeks (44.5% versus 50.5%; a 11.70% reduction; $p < .001$, $d = .14$, 95% CI: .12, .17; Figure 1, fourth pair of bars).

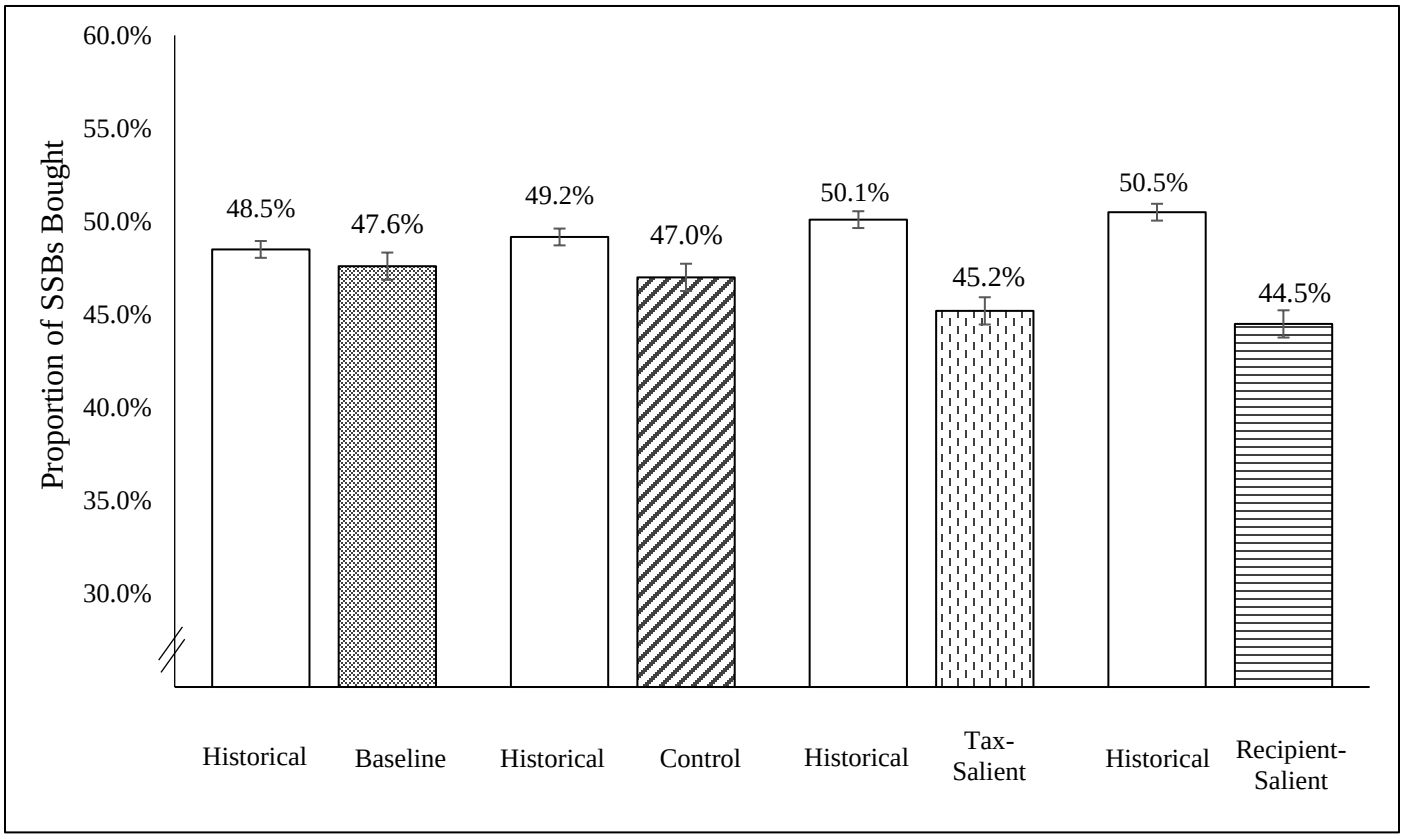
Table 4. Effect of tax-salient conditions on the share of SSBs bought, controlling for store, humidity, and heat index.

Fixed Effect	*β*	*t*	*p*
Constant	0.00	179.87	< 0.001
Tax-Salient	-0.22	-2.04	0.045
Recipient-Salient	-0.34	-3.38	0.001
Store 1 vs. Store 2	1.89	25.38	< 0.001
Daily Average Temperature	-0.04	-1.05	0.298
Daily Average Humidity	0.08	1.73	0.088
Tax-Salient*Store	0.05	0.27	0.787

Recipient-Salient*Store	0.022	0.11	0.914

Note. The model accounted for a considerable amount of variance (Adjusted R^2 = .901). The omitted intervention period was the control condition, therefore coefficients on each of the dichotomous treatment variables indicate differences relative to the control condition. There was a main effect of location: Store 1 sold a greater share of SSBs (*M* = 49.5%, *SD* = 2.0%) than Store 2 (*M* = 38.0%, *SD* = 2.3%). However, location did not interact with intervention period: the interaction term is non-significant between store and tax-salience (*p* = .787) and between store and recipient-salience (*p* = .914).

Figure 1. The share of SSBs bought, by condition, alongside matched calendar week historical controls.



Substitution Analysis. The substitution analysis indicated that during tax-salience, water buying increased relative to pre-tax (7.93% increase; $p < .001$, $d = .06$, 95% CI: .04, .09), baseline (9.80% increase, $p < .001$, $d = .08$, 95% CI: .05, .11), and control levels (6.94% increase; $p < .001$, $d = .06$, 95% CI: .03, .09); and was similar to recipient-salient levels (2.90% decrease; $p = .10$, $d = .02$, 95% CI: -.01, .05). Similarly, diet soda buying increased relative to pre-tax (36.03% increase; $p < .001$, $d = .13$, 95% CI: .09, .17), and baseline (15.71% increase, *p*

< .001, *d* = .06, 95% CI: .01, .12), but was similar to control levels (7.09% increase; *p* = .31, *d* = .03, 95% CI: .-.03, .09); and recipient-salient levels (3.31% increase, *p* = .64, *d* = .01, 95% CI: -.04, .07). Purchasing of other non-SSBs (milk, juice, unsweetened tea and coffee) did not show a clear pattern as a function of study period (see Supplement A3).

To summarize, Study 1 indicated that introducing a $0.01/ounce SSB tax—without making it salient on price tags—had no effect on purchasing. However, making the tax salient, by adding "Includes SF Sugary Drink Tax" to tax-inclusive price tags decreased SSB purchasing—by 9.78% relative to matching calendar weeks from pre-tax periods; by 5.04% relative to a baseline period in which the SSB tax was in effect but drinks did not bear price tags; and by 3.83% relative to the control condition in which drinks bore tax-inclusive price tags (but made no mention of the SSB tax). Results of the substitution analysis suggested that tax-salience led some consumers to buy water and diet soda in lieu of SSBs.

A recipient-salient price tag (which conveyed that the tax proceeds would go to student programs) was just as effective at reducing SSB purchasing as the tax-salient price tag. We surmise that we did not observe a licensing effect (whereby the charitable donation makes people feel "entitled" to behave unhealthfully, spurring SSB purchasing; Khan & Dhar, 2006) because a countervailing effect – tax aversion (i.e., the desire to avoid taxes; Sussman & Olivola, 2011) – may have been stronger (Blanken, van de Ven & Zeelenberg, 2015). We investigate this idea further in Study 2.

Study 2: (Over)estimating the Tax Amount

Given that people are generally averse to taxes (Sussman & Olivola, 2011), in Study 2 we evaluated whether the effect of the tax-salient price tag was driven by a tendency to overestimate the tax amount. In a simulated shopping task, participants indicated their willingness to buy a SSB. Between-subjects, we manipulated the price tags: half of participants were shown a control price tag which simply displayed the tax-inclusive price; the other half a tax-salient tag (akin to those used in Study 1). We predicted a replication of Study 1, whereby purchase interest would be lower in the tax-salient condition relative to the control condition. Moreover, we predicted this effect would be driven by participants' inferences of the tax amount.

Methods

We pre-specified a sample size of 400 respondents based on a power analysis using the parameters: power set to 90% ($\beta = 0.10$), Type I error rate of 5% ($\alpha = 0.05$), and a small effect (Cohen's d = .30). This analysis suggested that we would need 380 participants; to be conservative, we decided a priori to recruit 400. The study was pre-registered: http://aspredicted.org/blind.php?x=b8aw8b; and data and stimuli are posted: https://bit.ly/2vTGgbz.

We recruited participants (N = 400; M_{age} = 39.10, SD = 11.95; 49.5% female, 78.8% Caucasian; see Table 5 for full demographics for all studies, including a comparison to the latest US census data) from Amazon's mechanical turk who reported regularly drinking SSBs. To do so, we followed the procedures of Donnelly et al. (2018) in which participants were asked, "Do you drink soda?" Participants who responded "no" were told they did not qualify for the survey. If the participant responded "yes," they continued to the next question which asked, "When you drink soda, do you usually drink regular, full calorie soda (e.g., Coke, Pepsi) or diet, no-calorie

soda (e.g., Diet Coke, Coke Zero, Diet Pepsi)?" Participants who responded "Diet, No-Calorie Soda" were told they did not qualify for the survey. If the participant responded "Full Calorie Soda" they continued to the rest of the survey. At the end of the survey we also asked participants: "How often do you drink sugary drinks? (e.g., regular soda, sports drinks, sweetened teas, juice drinks. Do not include diet or sugar-free drinks)." Participants were given nine response options: (a) never, (b) 1 time per month, (c) 2-3 times per month, (d) 1-2 times per week, (e) 3-4 times per week, (f) 5-6 times per week, (g) 1 time per day, (h) 2 times per day, (i) 3 or more times per day. As specified in our pre-registration, participants who responded (a) were excluded from our analyses.

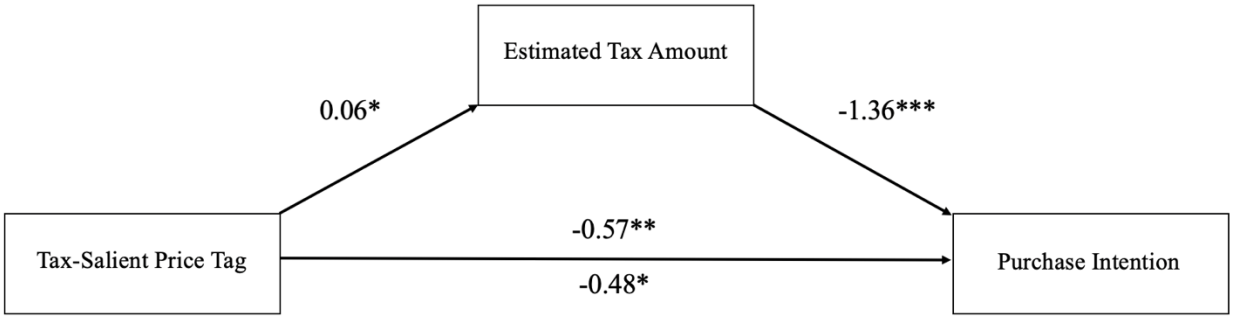
Participants imagined they were at a convenience store and considering buying a sugary drink. Participants reported their preferred SSB and were presented with an image depicting a 12-ounce can of it (e.g., Coca-Cola). Between-subjects, we manipulated the price tags: in the control condition, participants viewed the control as in Study 1 (e.g., "Coca-Cola, $1.52'). In the experimental condition, participants viewed the tax-salient price tag as in Study 1 (e.g., "Coca-Cola, $1.52, includes sugary beverage tax"). Participants stated their purchase interest on a scale from -3, *Definitely Not Buy* to +3, *Definitely Buy.* Participants also provided a SSB tax estimate; they were asked: "If you had to guess, how much of this $1.52 is a sugary beverage tax? Please indicate a dollar amount between $0.00 and $1.52 in the space below"; participants recorded their answer into a text-box. The order of these two measures was counterbalanced. The study concluded with basic demographic questions.

Results

Purchase intention was lower in the tax-salient condition relative to the control condition ($M_{\text{tax-salient}}$ = .44, *SD* = 1.90; M_{control}= 1.02, *SD* = 1.84; *t*(398) = 3.06, *p* = .002, *d* = .31, 95% CI = [.11, .50]). Interestingly, in both conditions, tax estimates were significantly higher than $0.12 – i.e., the amount of the San Francisco tax on a 12-ounce drink ($M_{\text{tax-salient}}$ = $0.40, *SD* = $0.27, *t*(200) = 14.64, *p* < .001, *d* = 1.01, 95% CI = [.86, 1.20]; M_{control}= $0.34, *SD* = $0.27, *t*(198) = 11.27, *p* < .001, *d* = .80, 95% CI = [.64, .96]). Importantly however, as predicted, tax estimates were higher in the tax-salient condition relative to the control condition (*t*(398) = 2.44, *p* = .015, *d* = .24, 95% CI = [.05, .44]). The hypothesized mediation was found: tax-salient price tags increased tax estimates, in turn reducing purchase intention (*b* = -0.09, *SE* = .046, 95% CI = [-0.19, -0.02]; SPSS PROCESS Macro, Model 4 (Hayes & Preacher, 2014)). See Figure 2.

Stemming from the notion that taxes evoke disdain, Study 2 suggests that tax-salient price tags were effective partly because consumers overestimate the tax amount, in turn reducing purchase intention. In support of this process account, the tax-salient tag lead to higher tax estimates relative to the control condition. As further support for this mechanism, a correlational version of this study pointed to the same conclusion (see Supplement B1).

Figure 2. Tax-salient price tags increased tax estimates, in turn reducing purchase intention.



Note. Path coefficients are standardized regression weights. On the path from tax-salient price tag to purchase intention, the coefficient above the line represents the direct effect without the mediator in the model, and the coefficient below the line represents the direct effect with the mediator in the model. Asterisks indicate significant paths (*p < .05, **p < .01, ***p < .001).

Table 5. *Sample Characteristics (for all studies in which demographic data were collected)*

		Study 2	Study 3
Age		39.10 years, *SD* = 11.95	37.90 years, *SD* = 11.76
Gender	Female	49.5% (-1.3%)	52.9% (+2.1%)
Race	White	78.8% (+3.7%)	78.0% (+2.9%)
	Black	8.0% (-6.1%)	12.0% (-2.1%)
	Asian	10.0% (+3.2%)	7.0% (+0.2%)
	Other	3.3% (-0.7%)	3.0% (-1.0%)
Hispanic	Yes	6.5% (-11.8%)	7.6% (-10.7%)
Education	High School or less	10.3% (-23.3%)	16.0% (-17.6%)
	Some college	16.8% (+0.3%)	18.7% (+2.2%)
	Associate's degree	13.5% (+2.6%)	11.2% (+0.3%)
	Bachelor's degree	45.3% (+21.5%)	40.4% (+16.6%)
	Graduate degree	14.2% (-0.9%)	13.6% (-1.5%)
Income	Less than $25,000	12.8% (-4.2%)	15.8% (-1.2%)
	$25,000 - $49,999	28.1% (+8.0%)	30.3% (+10.2%)
	$50,000 - $74,999	21.9% (+5.4%)	22.6% (+6.1%)
	$75,000 - $99,999	19.6% (+7.3%)	13.0% (+0.7%)
	$100,000 - $149,999	11.6% (-3.9%)	13.4% (-2.1%)
	$150,000 or more	6.0% (-12.5%)	4.8% (-13.7%)
SSB Consumption	1 time per month	7.3%	5.6%
	2 -3 times per month	21.1%	24.1%
	1 – 2 times per week	27.8%	23.6%
	3 – 4 times per week	17.0%	15.8%
	5 – 6 times per week	8.3%	9.6%
	1 time per day	9.0%	9.0%
	2 times per day	5.5%	6.9%
	3 or more times per day	4.0%	5.3%

Note. For attributes for which US census data is available, we indicte in parentheses, the percentage point deviation between our sample and that of the latest, 2018, US census data. Demographic data were not collected in Study 1.

Study 3: High Versus Low Tax

Methods

In Study 3, we sought to conceptually replicate Study 1, and, building on Study 2, we sought to provide convergent evidence of underlying process. Specifically, in Study 3, we

compared the performance of the tax-salient tag (which mentioned the presence of a tax, but not its amount) to three key comparators. First, as a conceptual replication of Study 1, we compared it to a control tag, which listed the tax-inclusive price but made no mention of tax (as in Study 1). Second, as convergent evidence of underlying process, we compared the tax-salient tag to two different tags that indicated the specific amount of the tax: a low-tax-revealed condition, which revealed that the price included a relatively small, $0.01 SSB tax per ounce; and a high-tax-revealed condition, which revealed that the price included a much higher, $0.033 tax per ounce. We reasoned that if the tax-salient tag is effective because people overestimate the tax amount, then it should produce purchase (dis)interest similar to that of the high-tax-revealed condition.

We recruited participants (N = 809; M_{age} = 37.90, SD = 11.76; 52.9% female, 78.0% Caucasian; see Table 5 for full demographics for all studies, including a comparison to the latest US census data) from Amazon's mechanical turk who reported regularly drinking SSBs (the screening procedure was the same as that used in Study 2). We pre-specified a sample size of 200 respondents per condition based on recent thinking on sample size (Simmons, Nelson, & Simonsohn, 2011). The study was pre-registered: http://aspredicted.org/blind.php?x=ca2r4g; and data and stimuli are posted: https://bit.ly/2vTGgbz.

Participants imagined they were at a convenience store and considering buying a SSB. Participants reported their preferred SSB and were presented with an image depicting a 12-ounce can of it (e.g., Coca-Cola). Between-subjects, we manipulated the tax information that was on the price tags; participants were randomly assigned to one of four conditions. In the control condition, participants viewed the control price tag as in Studies 1 and 2 (e.g., "Coca-Cola, $1.52'). In each of the other three conditions, we added text to this base tag. As in Study 2, in the tax-salient condition we added: "Includes Sugary Beverage Tax." In the low-tax-revealed

condition we added: “Includes $0.12 Sugary Beverage Tax” – i.e., a $0.01 tax per ounce. In the high-tax-revealed condition we added: “Includes $0.40 Sugary Beverage Tax” – i.e., a $0.033 tax per ounce, the average estimate from Study 2’s tax-salient condition. Participants stated their purchase intention on a -3, *Definitely Not Buy* to +3, *Definitely Buy* scale. The study concluded with basic demographic questions.

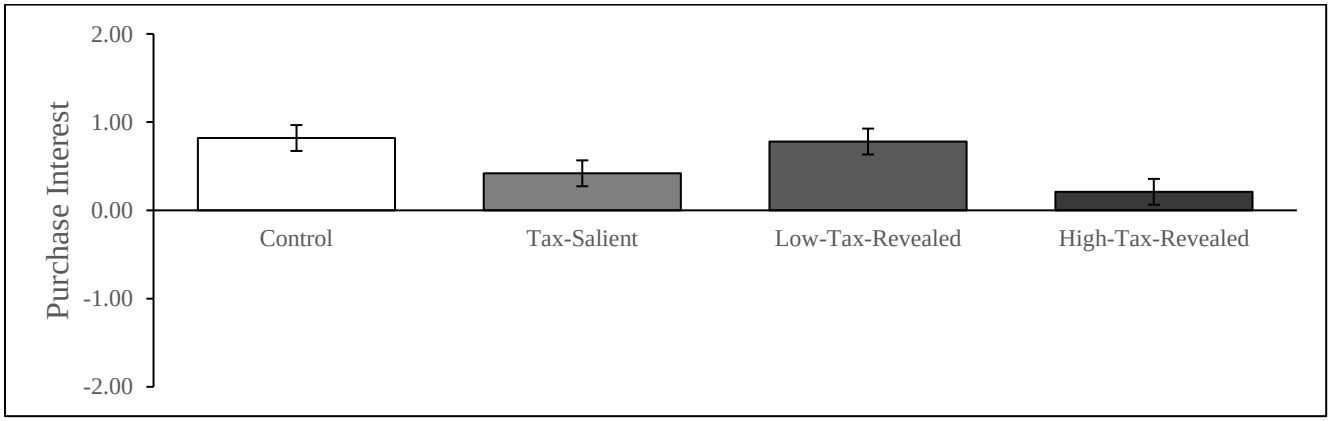
Results

Planned contrasts revealed that, as predicted, relative to the control condition ($M_{control}$= .82, SD = 1.83), purchase interest was reduced in both the tax-salient ($M_{tax\text{-}salient}$ = .42, SD = 1.89, $t(805) = 2.11$, $p = .036$, $d = .21$, 95% CI = [.01, .41]) and high-tax-revealed conditions ($M_{high\text{-}tax\text{-}revealed}$ = .21, SD = 1.99, $t(805) = 3.27$, $p = .001$, $d = .32$, 95% CI = [.13, .52]). Purchase interest was just as high in the low-tax-revealed condition ($M_{low\text{-}tax\text{-}revealed}$ = .78, SD = 1.82) as the control condition, $t(805) = .19$, $p = .85$, $d = .02$, 95% CI = (-.18, .21). In further support of our account, purchase interest in the tax-salient condition was more similar to that of the high-tax-revealed condition ($t(805) = 1.15$, $p = .25$, $d = .11$, 95% CI = [-.08, .31]) than to that of the low-tax-revealed condition ($t(805) = -1.91$, $p = .056$, $d = .19$, 95% CI = [-.39, .00]).

In sum, price tags that denoted the presence of a SSB tax, but not its amount, suppressed purchase interest to a similar degree as price tags that denoted a tax of $0.033 per ounce. By contrast, price tags that denoted a much lower tax amount, of $0.01 per ounce, did not suppress purchase interest relative to a control condition in which no mention was made of the tax. Thus, this study provides further evidence of our process account, namely that Study 1’s tax-salient tag was effective partly because people overestimate the tax amount. As further support for this mechanism, a conceptual replication of this study points to the same conclusion (see Supplement

B2). Taken together, these results imply that making a SSB tax salient on price tags can serve to reduce SSB buying, though this effect may be reduced or eliminated when the tax amount is low and stipulated on the price tag.

Figure 3. Drink choice as a function of condition



Note. Purchase Interest was measured on a +3 (*Definitely Buy*) to -3 (*Definitely Not Buy*) scale. The error bars indicate 1 +/- SEM.

General Discussion

A recent commentary concluded that "the effect of an excise tax on sugar-sweetened beverage consumption depends on two factors: the extent to which the tax is "passed through" to consumers… and consumers' responsiveness to the increased price" (Powell, & Maciejewski, 2018)." The present research points to an additional consequential factor: whether the tax is made salient on price tags. In fact, as observed in Study 1, it was only when the tax was made salient on price tags that it reduced SSB buying. Moreover, this reduction was offset by increased purchasing of water and diet soda (as opposed to reducing drink purchasing overall),

which bodes well for eliciting retailers' cooperation in implementation. Studies 2 and 3 suggested the effect of the tax-salient tags to be driven by overestimation of the tax amount.

Our results are consistent with a prior study showing that making taxes salient on price tags can decrease purchasing of everyday household items (Chetty, Looney and Kroft, 2009). However, in this previous work, the amount of the tax was conveyed on the price tags. By contrast, we show that tax-salience can be effective without showcasing the tax amount. Moreover, our results suggest that when the tax amount is low, price tags that denote the specific amount of the tax can be less effective than those that do not. Further, the present research helps to explain prior work, which has found that SSB purchasing decreased after the introduction of an SSB tax (Roberto et al. 2019). This work collapses across how the SSB taxes were conveyed; our research suggests that the effect was driven by stores that made the SSB tax salient on price tags. Future research could explore whether this reduction translates into improved health outcomes such as weight loss. In this regard, it is promising that the decrement in SSB purchasing corresponded with a reduction in average caloric content of purchased drinks, as well as an increase in water-buying.

With respect to study design, testing our interventions in the field enabled us to evaluate the impact of price tag labeling on SSB buying, but the quasi-experimental nature of our design does not allow us to account for ordering effects of our interventions, nor how these effects may be moderated by shopping frequency. For example, it is possible that repeat customers experienced more than one intervention and their buying decisions may have been influenced by a previous intervention, or an accumulation of more than one intervention. We sought to minimize the possibility for such carry-over effects by including washout periods, as has prior work (Bleich et al., 2014; Donnelly et al., 2018). In line with previous research evaluating SSB

taxes, we tested the effects of our intervention over a relatively short time span (Blake et al., 2018; Zhong, Auchincloss, Lee, and Kanter, 2018). Longitudinal studies, combined with shopper-intercept studies, could assess the longer-term effectiveness of our intervention. We also used convenience samples in Studies 2 and 3 which were not perfectly nationally representative (see Table 5 for how our sample characteristics compare to that of the latest U.S. census data). Future research should evaluate whether race, ethnicity, or other demographic variables moderate our results.

Practically, our results provide preliminary guidance on how to communicate SSB taxes at point-of-purchase for maximal impact. Our results suggest that when the tax is higher than consumers' intuitions, price tags that denote the specific amount of the tax will be more effective at curbing SSB buying than those that do not. What about when the tax is lower than consumers' intuitions? At present, arguably all SSB taxes in the United States fall into this category (for they are all far lower than our respondents' typical estimates of the tax amount)[3], so this question is particularly relevant. But the prescription in this case is murkier. Our results suggest that not stating the exact tax amount would be more likely to curb SSB buying than stating it. However, such a prescription raises new questions: is it "right" or "fair" to "hide" the amount of the tax? Over time, might hiding the tax backfire? Indeed, prior work indicates that when people feel a though information has been hidden from them, trust is undermined (John, Barasz, & Norton, 2016).

Future work is needed to better understand the effects of revealing specific tax amounts on purchasing. For example, whether the tax amount is simply reflected in a higher price (relative to non-taxed items) or explicitly spelled out could affect whether the tax is perceived as

[3] Currently seven US cities have SSB excise taxes: four cities in California ($0.01 per ounce); Philadelphia ($0.015 per ounce); Seattle ($0.0175 per ounce); Boulder ($0.02 per ounce).

large or small (Dehaene, 1992). Moreover, our results hint that such relationships could be moderated by the size of the tax, whereby small taxes may be perceived as essentially zero when price tags reveal their exact amount (as opposed to simply displaying the tax-inclusive price; see Reyna & Brainerd, 2002). Such relationships could also be moderated by product placement: placing SSBs next to their non-SSB counterparts could facilitate comparative processes; grouping all SSBs together, away from their non-SSB counterparts, could inhibit such processes (Hsee, Loewenstein, Blount, & Bazerman, 1999). More research is needed to answer such questions.

Conclusion

This field study is the first to test how the labeling of a SSB excise tax impacts SSB buying. Taken together, our studies suggest that to have their intended impact, such taxes should be made salient on price tags.

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Supplemental Material

A Salient Sugar Tax Decreases Sugary Drink Buying

TABLE OF CONTENTS

A1. Recipient-Salient Tag Comprehension Pre-Test: Convenience Sample

To test how the labeling of a SSB tax impacts SSB buying in the field, we first had to develop our intervention tags using a combination of conversations with our field partner and a pilot study. Because the recipient-salient tag would convey information that was slightly more complex than the others, we pretested several versions of it. We then selected the version that was most comprehensible for use in Study 1. Here, we report this pre-test.

Pretest

Stimuli Development. Our preference was for the recipient-salient tags to denote that the tax proceeds went to the university's student programs (e.g., "Includes San Francisco Sugary Drink Tax – Tax Proceeds Given To [University] Student Programs"). However, our field partners were uncomfortable with this messaging because they were worried it implied that they were not acting lawfully—that instead of collecting and paying the tax to the city, they had decided to simply donate the equivalent of the tax to student programs. Therefore, we worked with them to create tags that they were comfortable with and that successfully communicated the charitable recipient of the tax funds. We came up with three ways of phrasing this information (all three of which were satisfactory to our field partner): (A) "We match and donate tax proceeds to [University] student programs," (B) "Proceeds matched and donated to [University] student programs," and (C) "[The store] matches and donates proceeds to [University] student programs."

Pretest Study Design. We conducted a pretest to ascertain which of these three different phrasings generated the greatest comprehension. Specifically, after showing the label to participants, we assessed whether they could correctly identify its gist – i.e., that "The store will match and donate the tax proceeds to [University] student programs," amid the distractors: "The

city will match and donate the tax proceeds to [University] student programs," "The university will match and donate the tax proceeds to [University] student programs," and "None of these." We also assessed whether participants could identify who was imposing the tax; we assessed whether they indicated the imposer to be "The city," amid the distractors: "The store," "The university," and "None of these." We also wondered whether comprehension may depend on whether the specific amount of the tax was indicated on the tag. Therefore, on each of the tags we pretested, the above phrasings were preceded with either "$1.52 Includes San Francisco Sugary Drink Tax" or "$1.52 Includes a $0.12 San Francisco Sugary Drink Tax." Therefore, we tested comprehension for six different tags produced by this 2x3 between-subjects design. We planned to select the tag that produced the highest comprehension scores for use in our field study. Stimuli and data are here: https://bit.ly/2vTGgbz.

Methods. Participants from Amazon's Mechanical Turk who indicated that they typically opted for sugary soda (as opposed to diet soda) ($N = 450$; $M_{age} = 36.44$, $SD = 11.39$; 48.3% female, 76.6% Caucasian) imagined that they were at a convenience store in San Francisco, buying a SSB. Next, we showed them one of the six versions of the recipient-salient tag. Then, on the next page, we administered the two comprehension check items described above. The survey concluded with demographic questions.

Results

Gist comprehension. The percent of participants who correctly identified the gist is presented in Table S1, broken down by condition. The highest accuracy rate was 93.2%, achieved by two of the tags: versions 3 and 5 (see Table S1) (chi square test of performance in

these two conditions pooled versus the other four conditions: $\chi^2(1, N = 450) = 3.54, p = .0599$; versus each other: $\chi^2(1, N = 148) = .00, p = 1.00$).

Identification of Imposer. The percent of participants who correctly identified that the tax was imposed by the city is presented in Table S1, broken down by condition. The highest accuracy rates, of 90.5% and 93.4% were achieved by versions 5 and 6, respectively (chi square test of performance in these two conditions pooled versus the other four conditions: $\chi^2(1, N = 450) = 160.45, p < .001$; versus each other: $\chi^2(1, N = 150) = .42, p = .52$).

Therefore, because it had the best overall performance, achieving an accuracy rate of 83.8% across both comprehension questions, we chose version 5 (i.e., "*Includes San Francisco Sugary Drink Tax,* [*The store] matches & donates tax proceeds to [University] student programs*") for our field study.

Table S1. *Comprehension Test Pass Rates by Condition and Test Question*

	We match and donate tax proceeds to [University] student programs		Proceeds matched and donated to [University] student programs		[The store] matches and donates proceeds to [University] student programs	
	Tax amount not listed Version 1	Tax amount listed Version 2	Tax amount not listed Version 3	Tax amount listed Version 4	Tax amount not listed Version 5	Tax amount listed Version 6
Gist	84.0%	89.3%	93.2%	90.8%	93.2%	85.5%
Imposer	42.7%	44.0%	17.6%	10.5%	90.5%	93.4%
Gist + Imposer	36.0%	37.3%	13.5%	7.9%	83.8%	80.3%

A2. Calories Bought

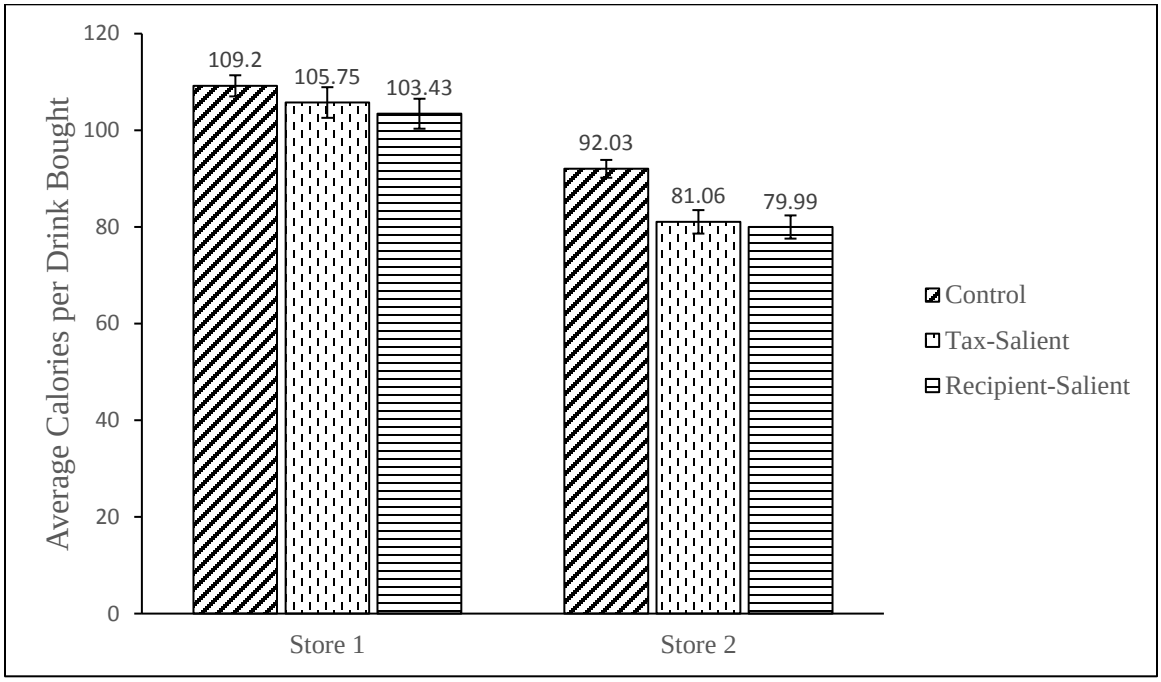
We conducted a linear regression predicting average calories per drink using temperature and humidity data to control for the daily maximum heat index. The model included dichotomous independent variables for each of the three tag interventions. Results are reported in Table S2. The tax-salient tag treatment was associated with a statistically significant drop in the average calories per drink bought ($p < .001$).

Table S2. *Effect of Tax-salient Conditions on the Average Calories per Drink Bought, Controlling for Store and Seasonality*

Fixed Effect	β	t	p
Constant		8.80	< 0.001
Tax-Salient	-0.42	-4.61	< 0.001
Recipient-Salient	-0.58	-6.42	< 0.001
Store 1 vs. Store 2	0.81	10.02	< 0.001
Daily Average Temperature	-0.02	-3.37	0.001
Daily Average Humidity	-0.004	-0.70	0.485
Tax-Salient*Store	0.30	3.12	0.002
Recipient-Salient*Store	0.25	2.60	0.009

Note. The omitted intervention period was the control price tag condition, therefore coefficients on each of the dichotomous treatment variables indicate differences relative to the control price tag condition. There was a main effect of store location: The average calories per drink sold was higher for Store 1 (M = 106.14, SD = 105.40) than Store 2 (M = 84.28, SD = 95.54). We posit this difference to be due to branding: Store 2, called "HealthyU" was branded as a health store; while Store 1 was a classic convenience store. Although there was a significant interaction between store and tax-salience (p = .002) and store and recipient-salience (p = .009), the pattern of average beverage calories sold was the same at both stores, see Figure S1.

Figure S1. *The Average Calories per Drink Bought by Store Location*



A3. Substitution Analysis by Drink Category

SSBs.

Soda Drinks. The substitution analysis indicated that during tax-salience, soda buying decreased relative to pre-tax (21.38% decrease; $p < .001$, $d = .13$, 95% CI: .11, .16); but was similar to no price tag baseline (4.76% decrease; $p = .20$, $d = .03$, 95% CI: -.07, .01); control price tag levels (6.60% decrease; $p = .06$, $d = .04$, -.08, .00) and recipient-salient levels (0.61% decrease; $p = .87$, $d = .00$, 95% CI: -.04, .04).

Sweetened Tea & Coffee Drinks. The substitution analysis indicated that during tax-salience, sweetened tea and coffee buying decreased relative to pre-tax (30.78% decrease; $p < .001$, $d = .22$, 95% CI: .19, .25), no price tag baseline (18.68% decrease; $p < .001$, $d = .10$, 95% CI: .06, .14); but was similar to control price tag levels (5.62% decrease; $p = .09$, $d = .03$, 95% CI: .00, .07) and recipient-salient levels (2.61% increase; $p = .86$, $d = .01$, 95% CI: -.02, .05).

Added Sugar Juice Drinks. The substitution analysis indicated that during tax-salience, added sugar juice buying was similar to pre-tax (6.00% decrease; $p = .08$, $d = .03$, 95% CI: -.01, .06), but increased relative to no price tag baseline (15.97% increase; $p = .005$, $d = .07$, 95% CI: .02, .12), control price tag levels (12.33% increase; $p = .02$, $d = .06$, 95% CI: .01, .10); and was similar to recipient-salient levels (7.98% increase; $p = .11$, $d = .05$, 95% CI: -.01, .09).

Non-SSBs.

Water. The substitution analysis indicated that during tax-salience, water buying increased relative to pre-tax (7.93% increase; $p < .001$, $d = .06$, 95% CI: .04, .09), no price tag baseline (9.80% increase, $p < .001$, $d = .08$, 95% CI: .05, .11), and control price tag levels

(6.94% increase, $p < .001$, $d = .06$, 95% CI: .03, .09), but was similar to recipient-salient levels (2.90% decrease; $p = .10$, $d = .02$, 95% CI: -.01, .05).

Diet Soda. The substitution analysis indicated that during tax-salience, diet soda increased relative to pre-tax (36.03% increase, $p < .001$, $d = .13$, 95% CI: .09, .17), and no price tag baseline (15.71% increase, $p < .001$, $d = .06$, 95% CI: .01, .12), but was similar to control price tag levels (7.09% increase, $p = .31$, $d = .03$, 95% CI: -.03, .09) and recipient-salient levels (3.31% increase, $p = .64$, $d = .01$, 95% CI: -.04, .07).

Unsweetened Tea & Coffee Drinks. The substitution analysis indicated that during tax-salience, unsweetened tea and coffee buying increased relative to pre-tax (14.08% increase; $p < .001$, $d = .06$, 95% CI: .03, .10), but did not significantly differ from no price tag baseline (7.78% decrease, $p = .11$, $d = .04$, 95% CI: -.01, .09), control price tag levels (2.32% increase, $p = .65$, $d = .01$, 95% CI: -.04, .06) or recipient-salient levels (1.65% increase, $p = .75$, $d = .01$, 95% CI: -.04, .06).

100% Juice Drinks. The substitution analysis indicated that during tax-salience, 100% juice buying decreased relative to pre-tax (18.97% decrease; $p < .001$, $d = .12$, 95% CI: .09, .12), and no price tag baseline levels (13.77% decrease, $p < .001$, $d = .08$, 95% CI: .04, .12), but was similar to control price tag levels (6.45% decrease; $p = .07$, $d = .04$, 95% CI: -.01, .08), and recipient-salient levels (2.52% increase, $p = .51$, $d = .01$, 95% CI: -.03, .05).

Milk Drinks. The substitution analysis indicated that during tax-salience, milk buying increased relative to pre-tax (183.33% increase; $p < .001$, $d = .38$, 95% CI: .32, .44), but was similar to no price tag baseline levels (12.39% increase; $p = .28$, $d = .04$, 95% CI: -.03, .12), control price tag (7.48% decrease; $p = .44$, $d = .03$, 95% CI: -.04, .10); and recipient-salient levels (15.44% decrease; $p = .13$, $d = .06$, 95% CI: -.01, .13).

Figure S2. *Posters Advertising the SSB Tax.*

Note. The photographs display signage that was voluntarily placed by our field partners and designed to make all patrons aware of the SSB tax. These posters were present throughout the entire duration of the field study.

Figure S3. *Bottled Beverage Cooler with Beverages and Price Tags.*

B1. (Over)estimating the Tax Amount – Correlational Evidence

Methods

To assess whether the tax-salient price tags led people to overestimate the amount of the tax, we recruited a sample of participants (N = 200; M_{age} = 36.35, SD = 12.00; 45.5% female, 72.0% Caucasian) from Amazon's mechanical turk who reported regularly drinking sugary beverages. We pre-specified a sample size of 200 respondents based on both recent thinking on sample size (Simmons, 2014; Simmons, Nelson, & Simonsohn, 2011) as well as a power analysis using the following parameters: power set to 90% ($\beta = 0.10$), Type I error rate of 5% ($\alpha = 0.05$), and a small effect (Cohen's d = .10). This power analysis suggested that we would only need 115 participants. However, to be conservative, and because we anticipated excluding participants who failed attention checks, we decided a priori to recruit 200 participants.

Participants imagined they were at a convenience store and were considering buying a sugary drink. Participants reported their preferred sugary drink and were presented with an image depicting a 12-ounce can of this beverage (e.g., Coca-Cola) priced at $1.52 with the same tax-salient price tag as in Study 1 (Table 1). Participants then stated their intention to purchase the beverage on a 1, *Definitely Not Buy* to 7, *Definitely Buy* scale and estimated the amount of the tax. Participants provided their estimate in an open response window that required a value between $0.00 and $1.52 (the total cost of the drink). The order of these two measures was counterbalanced between-subjects (there were no order effects; therefore, the results collapse across this factor). The study concluded with basic demographic questions and was pre-registered on AsPredicted.org (http://aspredicted.org/blind.php?x=ia5ai5; data and stimuli: https://bit.ly/2vTGgbz).

Results

We excluded 22 participants (according to our pre-registered criteria; results are substantively equivalent when we include all 200 participants in the analyses), leaving us with a final sample of 178 participants (M_{age} = 36.37, *SD* = 11.99; 45.5% female, 71.3% Caucasian).

On average, participants estimated that the tax amounted to $0.35 (*SD* = $0.25, 95% CI: .31, .38) per can—or a three cent per ounce tax, far larger than San Francisco's one cent per ounce sugary drink tax, $t(177) = 12.09$, $p < .001$. Further, purchase intent lowered the larger the tax was perceived to be ($r = -.20$, $p = .007$). Thus, tax-salience price tags may have reduced purchase intent because people overestimate the amount of the tax.

B2. High versus Low Tax

Methods

We recruited a sample of participants (N = 1,233; M_{age} = 36.33, SD = 11.59; 51.4% female, 74.1% Caucasian) from Amazon's mechanical turk who reported regularly drinking sugary beverages. We pre-specified a sample size of 300 respondents per condition based on recent thinking on sample size (Simmons, 2014; Simmons, Nelson, & Simonsohn, 2011).

Participants imagined they were at a convenience store and were considering buying a sugary drink. Participants were presented with an image of three drinks, each bearing a price tag: (a) a 12-ounce can of their favorite sugary soda (e.g., Coca-Cola) priced at $1.52, a 12-ounce can of its diet equivalent (e.g., Diet Coca-Cola) priced at $1.40, and (c) a 16.9-ounce bottle of water (Crystal Geyser) priced at $1.40.

Between-subjects, we manipulated the tax information that was on the price tags; participants were randomly assigned to one of four experimental conditions. The control price tag was the same as that used in Study 1 – i.e., it simply listed the (sugary drink tax-inclusive) price and made no mention of a sugary drink tax. In each of the other three conditions, we added text to the price tags. As in Study 1, in the tax-salient condition we added: "Includes Sugary Beverage Tax." In the low-tax-revealed condition we stated the tax amount, "Includes $0.12 Sugary Beverage Tax" – i.e., a one cent per ounce tax. In the high-tax-revealed condition we stated the tax amount, "Includes $0.35 Sugary Beverage Tax" – i.e., a tax of approximately three cents per ounce. Participants indicated which drink they would be most likely to buy. The study concluded with basic demographic questions and was pre-registered on AsPredicted.org (http://aspredicted.org/blind.php?x=v4qe6f; data and stimuli: https://bit.ly/2vTGgbz).

Results

We excluded 451 participants (according to our pre-registered criteria; results are substantively equivalent when we include all 1,233 participants in the analyses), leaving us with a final sample of 782 participants (M_{age} = 36.25, *SD* = 11.25; 51.9% female, 77.2% Caucasian). Next, we present the results of our four pre-registered predictions. See Figure 2 for the percentage of participants selecting each drink type, by experimental condition.

For each of the first three predictions, we assessed the propensity to order a sugary drink (1 = sugary drink, 0 = non-sugary drink) via multinomial regressions. First, we predicted and found that when tax information is included on the price tag, purchase interest of the sugary drink lowered relative to when no tax information is included on the price tag. Specifically, in the control price tag condition, 77.6% of participants chose the sugary drink, compared with 68.9% in the tax-salient condition (11.21% reduction; *OR* = .64, 95% CI: .41, .99, *p* = .048)—a conceptual replication of our field study.

Second, and stemming from Study 2, we predicted that the low-tax-revealed condition would not reduce demand for sugary drinks. Here, we found that sugary drink purchase interest in the low-tax-revealed condition fell in between that of the control price tag and tax-salient conditions. Specifically, 72.1% of participants selected the sugary drink in the low-tax-revealed condition – a percent that was statistically equivalent to the 77.6% of participants selecting the sugary drink in the control price tag condition (*OR* = .74, 95% CI: .47, 1.17, *p* = .20). However, it was also statistically equivalent to the 68.9% of participants selecting the sugary drink in the tax-salient condition (*OR* = 1.17, 95% CI: .74, 1.83, *p* = .50).

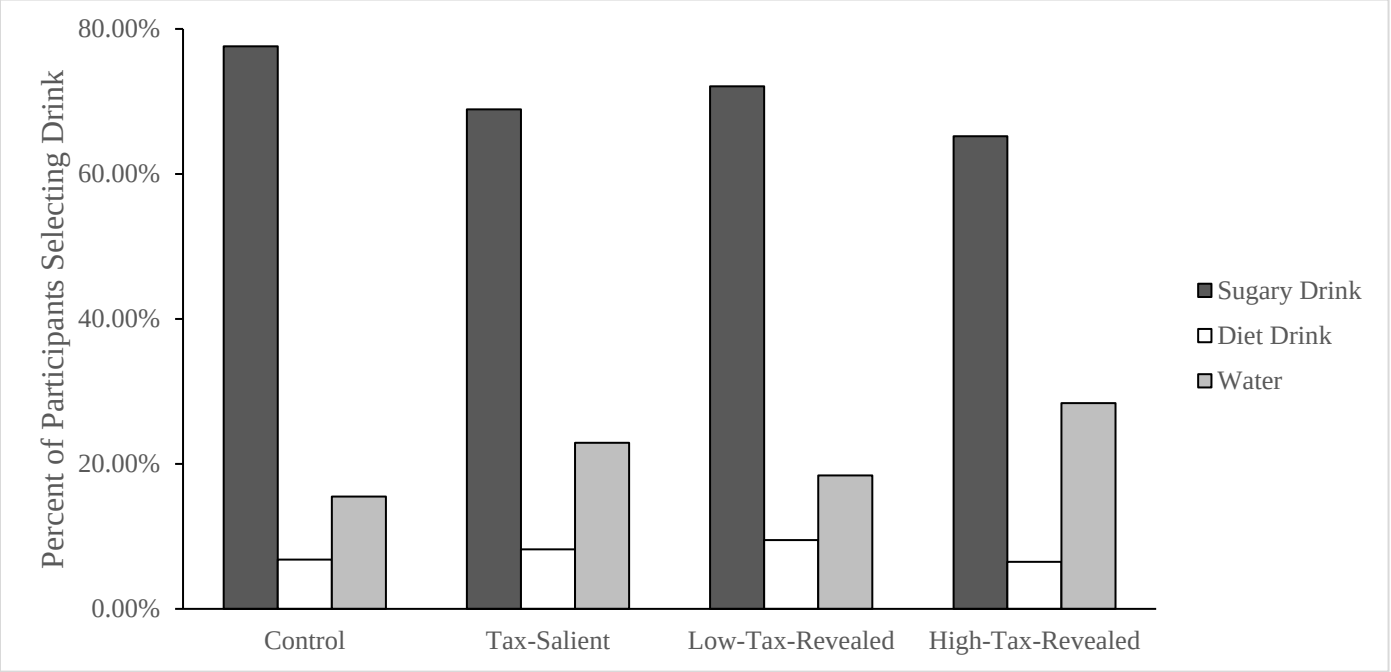
Third, and also stemming from Study 2, we predicted that the high-tax-revealed condition would lower demand for sugary drinks. Consistent with this prediction, the percentage of participants in the high-tax-revealed condition who selected the sugary drink – 65.2% - was

significantly lower than the 77.6% of those in the control price tag condition who did so (a 15.97% reduction; *OR* = .54, 95% CI: .35, .83, *p* = .005), and statistically equivalent to the 68.9% who did so in the tax-salient condition (*OR* = .85, 95% CI: .55, 1.30, *p* = .44).

In sum, these results suggest that the tax-salient and high-tax-revealed conditions reduced demand for sugary drinks. Our fourth prediction was that this reduced demand would be accompanied by an increase in water purchasing. To test this prediction, we conducted a multinomial regression predicting drink choice (1 = sugary drink, 2 = non-sugary drink, 3 = water), comparing both the tax-salient, and high-tax-revealed conditions to the control price tag condition. Supporting this prediction, in the tax-salient condition, 23.0% of participants selected water, compared with 15.5% in the control price tag condition (48.39% increase; *OR* = .60, 95% CI: .36, 1.00, *p* = .049). The percent of participants selecting the diet drink was equivalent across these two conditions (tax-salient = 8.2%; price-salient = 6.8%, *OR* = .74, 95% CI: .35, 1.57, *p* = .44). Likewise, in the high-tax-revealed condition, 28.4% of participants selected water, compared with 15.5% in the control price tag condition (82.22% increase; *OR* = .46, 95% CI: .28, .74, *p* = .002). The percent of participants selecting the diet drink was equivalent across these two conditions (high-tax-revealed = 6.5%; *OR* = .89, 95% CI: .41, 1.93, *p* = .77). By contrast and also consistent with the sugary drink choice share results above, relative to control, participants in the low-tax-revealed condition were similarly likely to select water (18.4%; *OR* = .78, 95% CI: .46, 1.33, *p* = .36) and diet drinks (9.5%; *OR* = .67, 95% CI: .32, 1.39, *p* = .28).

Taken together, the results suggest that our tax-salient price tag may encourage consumers to select water over a sugary drink – a benefit that may be reduced or eliminated when the tax amount is low and stipulated on the price tag.

Figure S4. *Drink Choice as a Function of Tag Type.*



Note. Bars sum to 100% within condition (i.e., within x-axis cluster).

Table S3. *Study Sample Characteristics Compared to U.S. Census Characteristics*

		Study 2	Study 3	Study B1	
Age		39.10 years, *SD* = 11.95	37.90 years, *SD* = 11.76	36.37 years, *SD* = 11.99	3
Gender	Female	49.5% (-1.3%)	52.9% (+2.1%)	45.5% (-5.3%)	
Race	White	78.8% (+3.7%)	78.0% (+2.9%)	71.3% (-3.8%)	
	Black	8.0% (-6.1%)	12.0% (-2.1%)	9.6% (-4.5%)	
	Asian	10.0% (+3.2%)	7.0% (+0.2%)	13.5% (+6.7%)	
	Other	3.3% (-0.7%)	3.0% (-1.0%)	5.6% (+1.6%)	
Hispanic	Yes	6.5% (-11.8%)	7.6% (-10.7%)	7.6% (-10.7%)	
Education	High School or less	10.3% (-23.3%)	16.0% (-17.6%)	13.6% (-20.0%)	
	Some college	16.8% (+0.3%)	18.7% (+2.2%)	24.3% (+7.8%)	
	Associate's degree	13.5% (+2.6%)	11.2% (+0.3%)	9.6% (-1.4%)	
	Bachelor's degree	45.3% (+21.5%)	40.4% (+16.6%)	40.7% (+16.9%)	
	Graduate degree	14.2% (-0.9%)	13.6% (-1.5%)	11.9% (-3.2%)	
Income	Less than $25,000	12.8% (-4.2%)	15.8% (-1.2%)	14.6% (-2.4%)	
	$25,000 - $49,999	28.1% (+8.0%)	30.3% (+10.2%)	33.1% (+13.0%)	
	$50,000 - $74,999	21.9% (+5.4%)	22.6% (+6.1%)	21.9% (+5.4%)	
	$75,000 - $99,999	19.6% (+7.3%)	13.0% (+0.7%)	18.0% (+5.7%)	
	$100,000 - $149,999	11.6% (-3.9%)	13.4% (-2.1%)	9.0% (-6.5%)	
	$150,000 or more	6.0% (-12.5%)	4.8% (-13.7%)	3.4% (-15.1%)	

Note. Values in the parentheses is the difference observed in our samples compared to the US Census.