



HHS Public Access

Author manuscript

Prev Med. Author manuscript; available in PMC 2024 February 01.

Published in final edited form as:

Prev Med. 2023 February ; 167: 107417. doi:10.1016/j.ypmed.2022.107417.

Should messages discourage sugary drinks, encourage water, or both? A randomized experiment with U.S. parents

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Abstract

Campaigns to improve beverage consumption typically focus on discouraging unhealthy beverages (e.g., soda), encouraging healthy beverages (e.g., water), or both. It remains unclear which of these strategies is most effective. We recruited a national convenience sample of U.S. parents of children ages 2–12 ($n=1,078$, 48% Latino[a]) to complete an online survey in 2019. We randomly assigned participants to view: 1) a control message, 2) a soda discouragement message, 3) a water

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Conflict of Interest Disclosures

The authors have no conflicts of interest to disclose.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Credit Author Statement

Author contributions are as follows. Anna H. Grummon: Conceptualization, Methodology, Data Curation, Formal analysis, Writing – Original Draft, Visualization, Funding acquisition. Allison J. Lazard: Conceptualization, Methodology, Writing – Review & Editing, Visualization, Funding acquisition. Lindsey Smith Taillie: Conceptualization, Methodology, Writing – Review & Editing, Funding acquisition, Supervision. Marissa G. Hall: Conceptualization, Methodology, Writing – Review & Editing, Funding acquisition, Supervision.

encouragement message, or 4) both soda discouragement and water encouragement messages shown side-by-side in random arrangement. Intervention messages mimicked New York City's "Pouring on the Pounds" campaign. Participants rated messages on perceived effectiveness for discouraging soda consumption and encouraging water consumption (1–5 response scales) and reported feelings and intentions about drinking soda and water (1–7 scales). Compared to those with no exposure, participants who viewed the soda discouragement message reported higher perceived discouragement from drinking soda (Average Differential Effect [ADE]=1.18), more negative feelings toward drinking soda (ADE=.83) and stronger intentions to avoid drinking soda (ADE=.45) ($p<0.001$). The soda discouragement message also exerted beneficial effects on perceived effectiveness, feelings, and intentions related to water consumption (ADEs=.33–.68; $p<0.001$). Exposure to the water encouragement message had beneficial effects on outcomes related to water consumption (ADEs=.28–.81, $p<0.001$), but limited impact on outcomes related to soda consumption. Across outcomes, results indicated diminishing returns from exposure to both message types. Messaging campaigns discouraging unhealthy beverages may be more promising for improving beverage consumption than messages only promoting healthier beverages.

Keywords

sugar-sweetened beverages; water; message; campaign; health communication; behavioral intervention; randomized experiment; nutrition

INTRODUCTION

Encouraging people to choose healthier beverages remains an important public health priority in the U.S. Overconsumption of sugar-sweetened beverages such as sodas and fruit-flavored drinks, for example, contributes to weight gain, obesity, type 2 diabetes, and cardiovascular disease.¹⁻⁵ By contrast, drinking water can prevent dehydration and replacing sugar-sweetened beverages with water can reduce body weight and improve blood pressure and fasting glucose.⁶⁻⁸ Despite some declines in sugar-sweetened beverage consumption over the past decade,⁹⁻¹¹ nearly 40% of adults and more than half of children consume sugar-sweetened beverages on any given day,¹⁰ and these beverages remain the leading contributor to added sugar in the American diet.¹² Moreover, consumption of sugar-sweetened beverages is higher among communities that have been historically marginalized, including Black and Latino(a) children and adults.⁹

Messaging interventions are a promising, scalable avenue for improving beverage consumption. Mass media campaigns, for example, use visuals and text to spur behavior change and have been shown to reduce purchases and consumption of sugar-sweetened beverages¹³⁻¹⁶ and increase consumption of tap water¹⁷ and low-fat milk.¹⁸ Messaging interventions aiming to promote healthier beverage consumption have taken varying approaches.¹⁹ Some campaigns focus on discouraging consumption of unhealthy beverages such as sodas and other sugary drinks. The "Pouring on the Pounds" campaigns used in San Francisco and New York City, for example, aimed to reduce sugar-sweetened beverage consumption by emphasizing the health risks of overconsuming these drinks.²⁰ Other

campaigns focus on encouraging people to choose healthier beverages such as water. For example, in 2016 New York City launched an advertising campaign that promoted water as a healthy, tasty, and accessible beverage.²¹ Some campaigns combine these approaches. Los Angeles County's "Choose Water" campaign, for example, used messages describing the health harms of sugary drinks as well as messages promoting water as the healthiest beverage choice.²²

Despite the widespread use of these approaches, it remains unclear whether it would be more advantageous for campaigns to focus on discouraging soda, encouraging water, or both.²³ The few studies that have compared these approaches side-by-side have focused only on parents' behavior toward their children, finding minimal differences between strategies.^{24,25} How these different messaging approaches influence parents' *own* beverage consumption intentions and behaviors remains unknown. Another unanswered question is to what extent messages designed to discourage people from drinking soda might also encourage them to drink water and vice versa, an important question given that nutrition education campaigns often have limited space to devote to any one topic. Therefore, to inform the design of beverage messaging campaigns, this study aimed to evaluate how parents respond to messages (including both visuals and text) that discourage soda, encourage water, or both.

METHODS

Participants

In October 2019, we recruited a national convenience sample of U.S. parents through the survey research firm CloudResearch Prime Panels for a separate study that evaluated the impact of beverage labels among U.S. parents.²⁶ The present study used the same sample as the primary study. Recruitment is described in detail elsewhere.²⁶ Briefly, participants were eligible if they were 18 years or older and had at least one child 2–12 years old. The primary study oversampled respondents who identified as Latino(a) to allow analyses to assess whether label impacts varied by ethnicity, information that could suggest whether labeling policies might affect nutrition-related disparities.²⁶ The sample size was determined for the primary study;²⁶ we did not conduct power analyses for this experiment. The University of North Carolina Institutional Review Board approved this study.

Procedures

Experimental Design—The experiment adopted a 2×2 factorial design, randomizing participants to 1 of 4 message conditions: 1) a control message, 2) only a soda discouragement message, 3) only a water encouragement message, or 4) both soda discouragement and water encouragement messages. These four conditions represent the combination of two experimental factors: exposure to a soda discouragement message (yes vs. no) and exposure to a water encouragement message (yes vs. no). Allocation was performed using Qualtrics survey software; Figure 1 depicts the CONSORT diagram.

Stimuli—We adapted the soda discouragement and water encouragement messages (i.e., text and visuals) from the "Pouring on the Pounds" campaign. We selected this campaign

because it has been used previously in multiple cities^{20,27} and because the materials were easily adaptable for both discouraging and encouraging messages. The soda discouragement message used text that mimicked the original campaign, reading, “Cut back on soda...Don’t pour on the pounds!”^{27,28} The message also included an image of soda turning into fat as it was poured into a glass, similar to the original campaign materials.²⁸ To create the water encouragement message, we adapted text from the “Pouring on the Pounds” campaign to focus on encouraging water consumption, while matching for length, tone, and syntax (“Drink more water... You are what you drink!”). To parallel the visual metaphor used in the soda discouragement message, the water encouragement message showed an image of water turning into the silhouette of a body in an active pose as it was poured into a glass. We also developed a control message that matched to the overall design of the two intervention messages, but focused on recycling and littering without mentioning health, similar to prior studies.^{26,29-31} Figure 2 shows the experimental stimuli.

Approach—After providing informed consent, participants completed an online survey programmed in Qualtrics. Participants first completed the primary experiment about beverage labels then completed the experiment for the present study. For the present experiment, participants viewed their randomly assigned message(s) and responded to survey questions about the message(s). Participants randomized to see both the soda discouragement and water encouragement messages viewed the two messages side-by-side in random arrangement. After responding to survey questions about the messages, participants provided demographic information.

After completing the survey, participants received previously agreed upon incentives from Prime Panels (e.g., reward points). Participants could choose to take the survey in English or Spanish. A professional translation company translated the survey and the messages. To ensure Spanish-speaking participants understood the translated survey and messages, we conducted in-person cognitive interviews with ten native Spanish speakers, as described elsewhere.²⁶ English and Spanish survey items appear in Supplemental Table 1, and Spanish stimuli appear in Supplemental Figure 1.

Measures

The co-primary outcomes were perceived message effectiveness for discouraging soda consumption (“discouragement from drinking soda”) and perceived message effectiveness for encouraging water consumption (“encouragement to drink water”). We focused on perceived effectiveness because experimental and meta-analytic evidence indicates that this outcome can predict actual message effectiveness.³²⁻³⁵ Discouragement and encouragement were each assessed with three items adapted from the UNC Perceived Message Effectiveness Scale³⁶ (e.g., “This message discourages me from wanting to drink soda,” and “This message makes me want to drink more water;” Cronbach’s alpha=0.90 for discouragement and 0.91 for encouragement). We cognitively tested each of the adapted Perceived Message Effectiveness items in an online survey ($n=456$) to confirm participants understood them. These items used 5-point response options ranging from “strongly disagree” (coded as 1) to “strongly agree” (coded as 5).

As secondary outcomes, the survey also assessed affective reactions (i.e., feelings) and intentions related to drinking soda and drinking water. We examined feelings³⁷⁻³⁹ and intentions³⁸⁻⁴⁰ because prior studies suggest that these constructs may be mechanisms through which messages change behavior. The survey assessed feelings toward the target behaviors with a single item for each behavior, adapted from a prior study³⁷ (e.g., “How does this message make you feel about drinking soda?”). Response options ranged from “extremely negative” (coded as 1) to “extremely positive” (coded as 7). The survey assessed intentions using one item for each behavior adapted from prior research⁴¹ (e.g., “In the next week, I plan to drink soda”), with response options ranging from “definitely not” (coded as 1) to “definitely” (coded as 7). We reverse-coded responses to the soda items such that higher scores indicated more negative feelings toward drinking soda and stronger intentions to avoid drinking soda. Finally, the survey assessed self-efficacy using one item for each behavior adapted from a prior study⁴² (e.g., “For me, not drinking any soda would be...”), with response options ranging from “very difficult” (coded as 1) to “very easy” (coded as 5).

Finally, the survey assessed demographic characteristics (e.g., age, gender) and sugar-sweetened beverage consumption. Sugar-sweetened beverage consumption was assessed with 2 items asking participants how often during the past 30 days they consumed sodas and fruit-flavored drinks⁴³ (1 item for each beverage type, see Supplemental Table 1). We summed responses to these items to estimate weekly consumption. We did not assess water consumption.

Statistical Analysis

We examined the effects of the experimental factors using ordinary least squares regression, regressing the outcomes on an indicator variable for exposure to the soda discouragement message (yes vs. no), an indicator variable for exposure to the water encouragement message (yes vs. no), and the interaction of these variables. To assess the main effects of the soda discouragement and water encouragement messages, we used the models to calculate unconditional average differential effects (ADEs) of being exposed to each message compared to not being exposed. We then tested whether the main effects for the two message topics (discouragement vs. encouragement) differed from one another by comparing the ADEs using Wald tests. Finally, we examined the interaction between the soda discouragement and water encouragement messages. We probed significant interactions by calculating ADEs at each level of the moderating variable (e.g., examining the effect of exposure to the water encouragement message when the soda discouragement message was absent vs. present). Prior to fitting final models, we conducted sensitivity analyses (not pre-registered) based on reviewer feedback to assess whether message effects in the present study differed by participants’ experimental group in the primary study. We added participants’ experimental group in the primary study to the models as well as the 3-way interaction between experimental group, exposure to the soda discouragement message, and exposure to the water encouragement message. The 3-way interactions were not significant for either co-primary outcome ($p > .24$), so final models excluded these interactions.

Finally, we conducted exploratory (i.e., not pre-registered) moderation analyses based on reviewer feedback to assess whether the impact of the messages differed by frequency of

sugar-sweetened beverage consumption. We added sugar-sweetened beverage consumption to the primary outcome models along with the 3-way interaction between consumption, exposure to the soda discouragement message, and exposure to the water encouragement message.

Analyses were conducted in Stata MP version 17 in 2022. Prior to data collection, we pre-registered the study's hypotheses and analysis plans on [AsPredicted.org](https://aspredicted.org/blind.php?x=xd53kb) (<https://aspredicted.org/blind.php?x=xd53kb>). In addition to conducting the unplanned sensitivity and moderation analyses described above, we made one other deviation from this plan: although we specified that we would examine the impact of exposure to *any* intervention message (regardless of topic) compared to the control, we opted against this collapsed analysis given the results indicated that the effects of the two message topics (discouragement vs. encouragement) differed from one another.

RESULTS

Sample Characteristics

Participants' average age was 35.3 years (SD 7.4) (Table 1). About half (48%) of the sample identified as Latino(a) (regardless of race). The majority of Latino(a) respondents were from Mexico (310 out of 514 Latino[a] respondents; 29% of the overall sample). Approximately 74% of participants identified as White, 13% as Black or African American, and 11% as another race or multiracial (regardless of ethnicity). Nearly half reported a household income of less than \$50,000/year, and 32% reported participating in the Supplemental Nutrition Assistance Program in the past year. Participant characteristics did not differ by experimental condition ($ps>0.13$) (Supplemental Table 2).

Main Effects of Exposure to the Soda Discouragement Message

Participants exposed to the soda discouragement message reported higher perceived discouragement from wanting to drink soda compared to those not exposed to this message (ADE=1.18, 95% CI: 1.05, 1.31, $p<0.001$; $d=1.05$; Figure 3). The soda discouragement message also led participants to have more negative feelings about drinking soda (ADE=.83, 95% CI: .63, 1.03, $p<0.001$; $d=.49$). Moreover, exposure to the soda discouragement message led participants to hold stronger intentions to avoid drinking soda (ADE=.45, 95% CI: .21, .69, $p<0.001$; $d=.23$).

The effects of the soda discouragement message also spilled over to influence outcomes related to water consumption. Specifically, participants exposed to this message reported higher encouragement to drink water (ADE=.68, 95% CI: .56, .80; $d=.61$), more positive feelings about drinking water (ADE=.63, 95% CI: .47, .78; $d=.47$), and stronger intentions to drink water (ADE=.33, 95% CI: .17, .49; $d=.25$) (all $ps<0.001$). The soda discouragement message did not affect self-efficacy to avoid drinking soda or self-efficacy to drink more water (both $ps>0.58$).

Main Effects of Exposure to the Water Encouragement Message

Participants exposed to the water encouragement message reported higher encouragement to drink water compared to those not exposed to this message (ADE=.81, 95% CI: .69, .94, $p<0.001$; $d=.74$; Figure 3). Exposure to the water encouragement message also led participants to have more positive feelings about drinking water (ADE=.80, 95% CI: .65, .96, $p<0.001$; $d=.61$) and to hold stronger intentions to drink water (ADE=.28, 95% CI: .12, .44, $p<0.001$; $d=.22$).

The water encouragement message generally did not lead to substantial spillover effects on outcomes related to soda. Specifically, although the water encouragement message led to higher discouragement from drinking soda (ADE=.37, 95% CI: .24, .50, $p<0.001$; $d=.31$), it did not affect feelings about drinking soda (ADE=.05, 95% CI: -.15, .26, $p=0.61$; $d=.04$) or intentions to avoid drinking soda (ADE=.20, 95% CI: -.04, .44, $p=.10$; $d=.10$). The water encouragement message did not affect self-efficacy to drink more water or self-efficacy to avoid drinking soda (both $ps>0.21$).

Comparing Effects of the Soda Discouragement Message and Water Encouragement Message

For outcomes related to soda consumption, the effects of the soda discouragement message were generally stronger than the effects of the water encouragement message. For example, the soda discouragement message exerted stronger effects than the water encouragement message on both perceived discouragement and feelings about drinking soda (ps for comparison of ADEs <0.001). The soda discouragement message also exerted somewhat (but not significantly) stronger effects than the water encouragement message on intentions to avoid drinking soda (p for comparison of ADEs=0.15).

By contrast, the two message topics exerted similar effects on all of the outcomes related to water consumption (all ps for comparisons of ADEs >0.12). For example, the soda discouragement message exerted a similar effect as the water encouragement message on intentions to drink water (ADEs= .33 and .28, respectively, p for comparison of ADEs=.67), despite the soda discouragement message not mentioning or depicting water.

Interactions Between The Soda Discouragement and Water Encouragement Messages

Exposure to the soda discouragement message interacted with exposure to the water encouragement message in their effects on all outcomes related to soda consumption (Supplemental Table 3, all ps for interactions <0.05), with the exception of self-efficacy to avoid drinking soda ($p=0.12$). The pattern of results indicated diminishing returns from viewing both types of messages: the effect of either message was weaker when it was presented next to the other message compared to when it was presented alone. For example, the water encouragement message led to higher discouragement from drinking soda when participants saw only this message (Mean [M]=3.44 when the encouragement message was presented vs. 2.46 when it was not; ADE=.98, $p<0.001$; $d=.81$; Figure 4). However, exposure to the water encouragement message *decreased* discouragement from drinking soda when participants were also exposed to the soda discouragement message at the same

time ($M=3.98$ vs. 4.25 ; $ADE=-.27$, $p=0.004$; $d=-.30$). The same pattern held for feelings and intentions toward drinking soda (Figure 4).

The water encouragement message and soda discouragement message also interacted in their effects on all outcomes related to water consumption (all p s for interaction <0.001 , Supplemental Table 3) except for self-efficacy to drink more water ($p=0.14$). Again, the results indicated that the effect of either message was weaker when it was presented alongside the other message compared to when it was presented alone. This pattern was again especially pronounced for the water encouragement message: across outcomes, the water encouragement message had beneficial effects only when it was presented alone, but had no benefits when the soda discouragement message was also presented (Figure 4).

Message Interactions with Sugar-Sweetened Beverage Consumption

The three-way interaction between exposure to the soda discouragement message, exposure to the water encouragement message, and sugar-sweetened beverage consumption was not significant for perceived discouragement ($p=0.16$) or perceived encouragement ($p=0.48$), suggesting there were not differences in message effects by sugar-sweetened beverage consumption.

DISCUSSION

In this randomized experiment, messages that discouraged soda consumption or encouraged water consumption led participants to have higher perceived encouragement to drink water, more positive feelings about drinking water, and stronger intentions to drink water. Moreover, the soda discouragement message (but not the water encouragement message) led participants to have higher perceived discouragement from drinking soda, more negative feelings about drinking soda, and stronger intentions to avoid drinking soda. Additionally, the soda discouragement message (but not the water encouragement message) had favorable spillover effects, leading to beneficial influences on perceived effectiveness, feelings, and intentions related to water consumption. Because perceived effectiveness, feelings, and intentions are each predictive of behavior change,^{32-35,37-40} these results suggest that messaging interventions—particularly messages discouraging sugary drinks—could be a valuable part of a suite of strategies used to improve beverage intake.

Exposure to the soda discouragement message led to beneficial effects on perceived effectiveness, feelings, and intentions regarding drinking soda. These results are consistent with prior evaluations of similar anti-sugary-drink mass media campaigns, which have found that exposure to these campaigns can change intentions and behavior.^{27,44,45} The soda discouragement message also spilled over to affect outcomes related to water consumption—including increasing intentions to drink water—even though this message did not mention or depict water. Moreover, the effects of the soda discouragement message on water-related outcomes were similar in magnitude to the effects of the water encouragement message on these outcomes, suggesting minimal downside to using soda discouragement messages to increase water intake. Together, these results suggest that soda discouragement messages could simultaneously reduce soda consumption and increase water consumption,

an important finding given that drinking water in place of sugar-sweetened beverages can improve blood pressure, reduce blood glucose, and decrease risk of overweight.^{6,8}

Exposure to the water encouragement message led participants to report higher encouragement to drink water, have more positive feelings about drinking water, and hold stronger intentions to drink water. These results suggest the promise of water promotion messages for encouraging parents to drink more water. The water encouragement message, however, did not affect feelings about drinking soda or intentions to avoid drinking soda. These results align with a systematic review that found that water-focused interventions did not consistently reduce purchases or consumption of sugary drinks.²³ Efforts to reduce consumption of unhealthy beverages may need to explicitly discourage these beverages, rather than only promoting healthier options.

Results indicated diminishing returns from exposure to multiple message topics simultaneously: across outcomes, the effects of soda discouragement message and water encouragement message were weaker when these messages were presented next to one another compared to when they were presented alone. This pattern was especially notable for the water encouragement message, which was generally beneficial when presented by itself, but led to null or even negative effects when it was added to the soda discouragement message. Possible reasons for the diminishing returns could include that the two messages competed with one another for participants' attention or that participants found it challenging to process both messages simultaneously, reducing the impact of either message.⁴⁶ Another potential explanation is that participants may have found it more challenging or restrictive to adopt both target behaviors at once, compared to adopting either behavior alone. Our results align with two recent experiments that found that adding encouragement messages to discouragement messages did not lead to benefits above presenting discouragement messages alone.^{24,25} Together, these findings suggest the value of simplicity when designing individual messages, such as a single campaign poster or social media post.

Strengths of this experiment include the randomized design and realistic experimental stimuli mimicking actual public health messaging campaigns. Limitations include that participants had only brief exposure to messages in the context of an online survey and we used only one message for each topic. Additionally, although we measured outcomes that are predictive of behavior change, we did not assess beverage consumption. Future studies should assess the impact of these messages on behavioral outcomes as well as potential unintended consequences such as reactance and weight-related stigma.^{47,48} We did not observe differences in message effects by sugar-sweetened beverage consumption but may not have been powered to detect such differences. Additionally, we did not assess how often participants drank water, so could not assess whether responses to the messages differed by water consumption. Finally, the study used a convenience sample that was comprised of parents; thus the generalizability to other populations remains to be established.

CONCLUSIONS

Messages discouraging soda consumption may simultaneously reduce soda consumption and promote water consumption. By contrast, messages encouraging water consumption may increase water consumption without reducing soda consumption. Messaging campaigns that explicitly discourage unhealthy beverages may therefore be more promising for improving beverage consumption than messages only promoting healthier beverages.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Funding

AHG was supported by K01 HL158608 and T32 HL098048. MGH was supported by K01 HL147713.

Role of Funder/Sponsor

The funders had no role in the management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; or decision to submit the manuscript for publication.

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Highlights

- Uncertainty remains about how to design impactful messages to encourage healthier beverage choices.
- This study randomized U.S. parents to view messages that discouraged soda consumption, encouraged water consumption, or both.
- Messages discouraging soda led to stronger intentions to avoid drinking soda.
- Messages discouraging soda also spilled over to increase intentions to drink water.
- Messages encouraging water led to stronger intentions to drink water but did not affect intentions to drink soda.

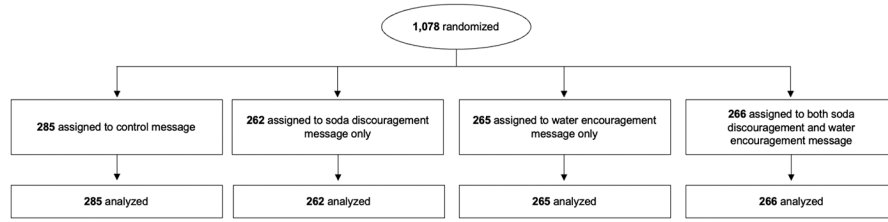


Figure 1.
CONSORT flow diagram

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Figure 2.

Soda discouragement (left), water encouragement (center), and control (right) messages used in the randomized experiment

Note. Participants randomized to view both the soda discouragement and water encouragement messages saw these two messages side-by-side in random arrangement.

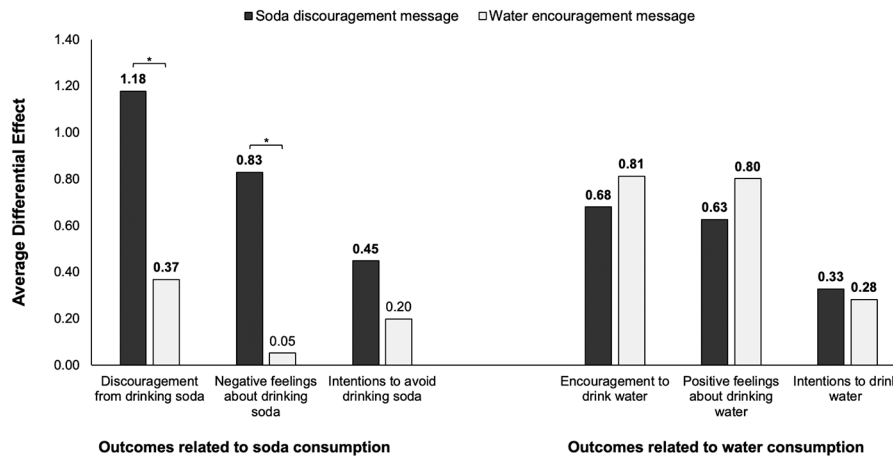


Figure 3. Impact of the soda discouragement and water encouragement messages on outcomes related to soda consumption and water consumption, $n=1,078$ U.S. parents of children ages 2–12
Note. Figure shows main effects (unconditional Average Differential Effects [ADEs]) for exposure to each beverage message (soda discouragement message or water encouragement message) compared to no exposure. ADEs shown in **boldface** are statistically significant, $p<0.001$. *indicates that ADEs for the soda discouragement message and water encouragement message differed from one another, $p<0.001$.

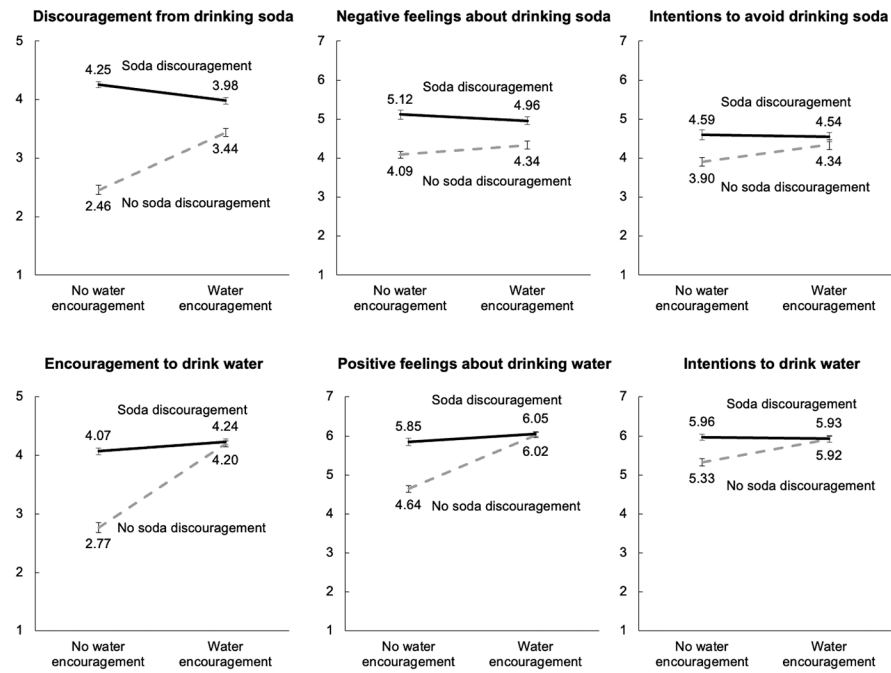


Figure 4.

Interactions between exposure to the soda discouragement message and the water encouragement message, $n=1,078$ U.S. parents of children ages 2–12

Note. Figure shows means (\pm SE) for outcomes. Response options ranged from 1 to 5 for discouragement from drinking soda and encouragement to drink water and 1 to 7 for all other outcomes.

Table 1.Participant characteristics, $n=1,078$ U.S. parents of children age 2–12

Characteristic	<i>n</i>	%
Age		
18-29 years	238	22%
30-39 years	563	52%
40-54 years	259	24%
55+ years	15	1%
Mean in years (SD)	35.3	7.4
Gender		
Man	445	41%
Woman	628	58%
Transgender or another gender	5	0%
Sexual orientation		
Straight or heterosexual	994	92%
Gay or lesbian	24	2%
Bisexual	49	5%
Another sexual orientation	11	1%
Latino(a) ethnicity		
Not Hispanic or Latino(a)	563	52%
Hispanic or Latino(a), Mexican	310	29%
Hispanic or Latino(a), all other countries of origin	204	19%
Race		
White	796	74%
Black or African American	135	13%
Asian	23	2%
Pacific Islander	2	0%
American Indian or Alaskan Native	1	0%
Another race or multiracial	121	11%
Education		
Less than a high school degree	39	4%
High school degree	473	44%
Four-year college degree	428	40%
Graduate degree	138	13%
Household income, annual		
\$0-\$24,999	213	20%
\$25,000-\$49,999	288	27%
\$50,000-\$74,999	202	19%
\$75,000+	375	35%
Supplemental Nutrition Assistance Program participation in past year	344	32%
Frequency of sugar-sweetened beverage consumption		
0 to 1 time per week	279	26%

Characteristic	<i>n</i>	%
>1 to <7 times per week	370	34%
1 to 2 times per day	205	19%
More than 2 times per day	224	21%
Language of survey administration		
English	924	86%
Spanish	154	14%

Note. Missing demographic data ranged from 0.0% to 0.3%.

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