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Richie L. Lenne, Traci Mann

Institutions: University of Minnesota

Published on: 01 Apr 2020 - Journal of Health Psychology (J Health Psychol)

Reducing Sugar Use in Coffee While Maintaining Enjoyment:

A Randomized Controlled Trial

Richie Lenne & Traci Mann

University of Minnesota

Department of Psychology

Post-Print (i.e., final draft post refereeing) for Journal of Health Psychology
June 26, 2017

Correspondence concerning this article should be sent to Traci Mann, Department of Psychology, 75 East River Road, Minneapolis, MN 55455. 612 625-5838. mann@umn.edu

Abstract

Consuming coffee without (or with less) sugar may help people lower their daily calorie intake without restrictive dieting. We tested two theory-based interventions to help people do so. One involved gradually reducing sugar over time, and the other was based on mindfulness theory. These interventions were compared to a repeated exposure (to sugar-free coffee) group. Participants in all conditions had significant increases in consumption of sugar-free coffee that lasted six months. The mindfulness group had a larger increase than the others. Unexpectedly, the gradual reduction intervention led to a decrease in liking for sugar-free coffee, and was the least effective.

Keywords: Reducing Sugar; Mindfulness; Dieting; Eating; Brief Interventions

Reducing Sugar Use in Coffee While Maintaining Enjoyment: A Randomized Trial

Levels of obesity have increased rapidly in the last forty years (Flegal et al., 2016), and efforts to treat it with calorie-restricting diets have had short-term, but not long-term success (Mann et al., 2007). Making several small changes to one's everyday eating habits (e.g., switching to diet soda instead of full-calorie soda; Miller and Perez, 2014) may be a more effective way to induce small but sustainable weight loss.

One part of many people's diets that has yet to be tapped for recurring calorie reduction is the sugar and fat that they add to their coffee. Over half of adult Americans drink coffee every day, averaging 3.1 cups per day (LaComb et al., 2011; An, 2016). Only a third of U.S. coffee consumers drink their coffee black. The rest add a sweetener, fat in the form of milk or cream, or both, resulting in an average daily caloric increase of 69 calories (An and Shi, 2017).

There are 48 calories in one tablespoon of sugar, and over the course of a day, some coffee drinkers may use their entire recommended daily allotment of added sugar (100 calories for women/150 for men; American Heart Association, 2014) just in their coffee. In addition, excess sugar consumption is not *only* linked to increased risk for obesity, it also increases risk for type 2 diabetes and cardiovascular disease, independent of obesity (Malik et al., 2010).

Entirely removing coffee from one's diet is not an optimal solution to this problem, as most individuals are not inclined to give up their daily coffee. One survey found that among people who had been regular coffee drinkers, only 20% no longer drank it (Hughes and Oliveto, 1997). Plus, correlational studies show an inverse relationship between coffee consumption and type 2 diabetes (Kempf et al., 2010; Salazar-Martinez, 2004; van Dam and Hu, 2005), although confounding variables (e.g. socioeconomic status) cannot be ruled out. Regardless of whether the specific chemical components of black coffee have a *causal* benefit for health, if it is used as a

substitute for a sugary beverage, on balance it will be a healthier tradeoff. Indeed, research has shown that replacing one sugar-sweetened beverage with black coffee daily leads to a 17% reduced risk for type 2 diabetes (De Koning et al., 2011).

Substituting low-calorie artificial sweeteners for sugar is also not an ideal solution for reducing calories (and sugar) in coffee because these sweeteners carry their own risks. Additions of commercial formulations of saccharin, sucralose, or aspartame have been shown to lead to the development of glucose intolerance, a precursor to diabetes, in both humans and mice (Suez et al., 2014). Introducing saccharin into the diets of healthy individuals led to disruptions in glycemic response in just one week. Further bolstering the causal relationship, these researchers discovered the mediational pathway (gut microbiota) through which artificial sweeteners led to glucose intolerance in mice (Suez et al., 2014).

Strategies for Reducing Sugar in Coffee

In this pre-registered randomized controlled trial, we devised and tested two interventions aimed at helping coffee drinkers stop adding sweeteners to their daily coffee. One intervention involves gradually and just barely detectably decreasing the amount of sugar added to coffee over time. This method has been used to reduce the salt in tomato juice, and liking for the juice did not decrease as salt was removed over fourteen weeks (Bobowski et al., 2014). Similar methods have been created for increasing the whole-wheat content of bread (Delk and Vickers, 2007). We expect this intervention to have the same effect: liking for coffee should not decrease as sugar is gradually reduced, and participants should drink their coffee sugar-free more often after the intervention ends than participants in the control group.

The second intervention is based on mindfulness theory (Brown et al., 2007), which encourages the moment-by-moment awareness of life with the goal of preventing people from

getting so caught up in their thoughts that they scarcely notice life as it is passing by them. Mindful eating interventions teach participants to 1) eat with great attention and focus so that they notice all sensory aspects of their food, and 2) increase their awareness of bodily sensations of hunger and fullness, so that they can regulate their appetite and consumption (Kristeller et al., 2013; Papies et al., 2011). These interventions have been successfully used to increase enjoyment of a typically avoided food (i.e., prunes; Hong et al., 2014), a food that evokes mixed feelings (i.e., raisins; Arch et al., 2016) and a liked food (chocolate; Arch et al., 2016). Our aim was not to train awareness of hunger and fullness, so we did not include those aspects of the training. Instead we focused on taste experience and taste satisfaction. Because coffee is a complex beverage, we also included a brief introduction to coffee tasting, so that when participants pay attention to their coffee, they are able to detect and appreciate its flavor, aftertaste, and other attributes. We expect that individuals who use this strategy will like unsweetened coffee more, and consume unsweetened coffee more often, than participants in the control condition.

In the control condition, participants are asked to give up sweeteners in their coffee for the duration of the study, without being given any strategy. This condition allows us to test whether the other interventions lead to increased liking of sugar-free coffee beyond what may result from being repeatedly exposed to it (Anzman-Frasca et al., 2012; Birch, 1990; Zajonc, 2001). These “mere exposure” effects, while small, have been documented in the literature with a host of stimuli (Zajonc, 2001), but they have not been consistently found with food. In particular, they have been found for some novel foods tested (Pliner, 1982; Stein et al., 2003; Mattes, 1994), as well as foods that, while not novel, were rarely eaten by the participants (Wardle et al., 2003a, 2003b; but see Bingham et al., 2005). Studies that test familiar foods tend to find decreased liking with repeated exposure (Pliner et al., 1980; Rolls et al., 1981).

Although coffee is familiar to participants in this study, coffee *without sugar* tastes quite different and is likely novel to them. We expect repeated exposure to lead to small but statistically significant increases in liking and consumption of unsweetened coffee over the course of the study, but we expect the other two interventions to lead to significantly larger increases.

Methods

Participants

Participants were recruited through flyers and online postings for a "study on how to reduce consumption of added sugar in coffee." The flyer indicated that they would be asked to attend a one-hour session and complete brief surveys on their phone for two weeks. Flyers were posted at local coffee shops. People in the subject pools of the food science department and the business school at a large Midwestern university were informed of the study over email, and participants in the psychology department's subject pool were notified via an online posting. Interested subjects visited a link containing a screener survey.

Individuals were accepted into the study if they indicated on the screener that they: (1) consumed at least 1 cup of coffee a day with added sugar, (2) drank regular cups of coffee or Americanos (rather than cappuccinos or lattes) most of the time, (3) were willing to remove sugar from their coffee for the 2-week study, (4) were 18 to 65 years old, (5) had a smartphone with internet access, (6) were confident (i.e., 7+ on a 9-point scale) in their ability to complete a brief survey each day for 14 consecutive days, and (7) were available during one of the nine study session dates. Eligible participants were then presented a list of available sessions, all on weekday mornings between February 11 and February 19, 2016, and they signed up for whichever was convenient for them. Although each session included only one of the study

conditions, participants were unaware of this and were blind to the condition to which they registered. Participants were compensated $40 at the end of the two-week study period, and entered into a raffle for one of two $50 Target gift cards at the six-month follow-up.

There were 254 individuals who started the screener, of whom 198 were eligible to participate. Of these, 193 scheduled a session online and 129 showed up for the session (see Figure 1 for consort diagram).

[Insert Figure 1]

Two subjects were removed for providing incomplete data based on a pre-registered exclusion rule (missing data on seven or more of the 14 intervention days), leaving a final sample of 127 participants (76% female) ranging in age from 18 to 62 years (n =126**,** M = 26.62, SD = 9.83), and body mass index from 17 to 41 (n = 125, M = 24.24, SD = 3.93). The sample is 76% White, 16% Asian, 4% Hispanic, 2% Black, and 2% Other. One participant failed to complete gender, age, and ethnicity questions. Two failed to complete BMI questions. Sample size, exclusion criteria, and stopping rules were pre-registered (osf.io/yq52s) and determined by balancing time and monetary constraints with power constraints. The Institutional Review Board of the university approved the study protocol.

Design

The study uses a mixed design. There is one between-subjects factor: subjects are randomly assigned (by session, using block randomization) to one of three sugar removal conditions. There is also a within subjects factor: Participants provide repeated measures on two variables (e.g., coffee enjoyment and attention to coffee) each day for 14 days, allowing the

examination of within-person changes over time.

Procedure

Subjects completed a screener for eligibility (T0), attended a training session (T1), responded to daily questions during a 14-day intervention period (T2), and responded to follow-up questionnaires at the end of the 14th intervention day (T3), and one-month (T4) and six-months (T5) after the 14-day intervention period ended.

Training (T1). Nine study sessions of 10 to 20 participants were conducted. Upon arrival subjects were seated, given a consent form, and were told about the study by a research assistant. Once participants had asked any questions and had them answered, they signed the consent form. Then they responded to demographic and personality questions, an assessment of their coffee consumption behavior over the last month, and their enjoyment of coffee as they normally drink it. Subjects were then poured a cup of coffee and instructed to add their normal amount and type of milk, cream, or creamer to the coffee. Subjects then tasted it and responded to measures of liking for this sugar-free coffee, and for the coffee after adding their usual amount of sugar. Next subjects were trained on how to complete the study questionnaire for T2 on their mobile device, and were instructed to respond to that survey after their first cup of coffee every day for the next two weeks. They were shown how to set a daily reminder for this task, and they were reminded that throughout the study, they were to continue to use their normal type and quantity of whitener (e.g., milk, cream) in their coffee. Once this standard training was finished, participants were given specific instructions based on their assigned condition. Once participants asked any questions and understood their instructions, they were provided a summary of their condition's procedures, thanked, and released.

Condition 1: Control. Participants in the control condition were instructed to drink their

coffee without any sweetener for the next two weeks. To keep expectations equivalent with the other conditions, they were told: "This might be challenging, but research shows that if you, for example, stop adding salt to your food, you will get used to it that way. We are trying this with sugar in coffee." This condition allows us to assess the effects of merely repeating exposure to sugar-free coffee (Anzman-Frasca et al., 2012; Birch, 1990; Zajonc, 2001).

Condition 2: Gradual Sugar Reduction. Participants in this condition were asked to gradually reduce the amount of sugar in their coffee. They were told that they would drink coffee with their normal amount of sugar on the first intervention day, and subsequently reduce the amount of sugar they add to their coffee every two days until they were drinking it with no sugar. To keep expectations about the effectiveness of all three interventions equivalent, participants were told: "This might be challenging, but research shows that if you, for example, gradually reduce the amount of salt in your food, you will get used to it that way. We are trying this with sugar in coffee."

Sugar was reduced by units of ⅙ of each participant's starting sugar amount. For example, if they normally put 3 teaspoons of sugar into their coffee, their standard deduction was ½ teaspoon. Thus, on day 2 they reduced by ½ teaspoon, thereby using 2 ½ teaspoons in their coffee that day. After two days at this sugar quantity, they reduced by another ½ teaspoon to 2 teaspoons. This reduction every two days continued until day 12, when their last reduction resulted in them having no sugar in their coffee at all for the final three days of the study.

Subjects were given individually-tailored packets with the exact amount of sugar they would need for each cup of coffee for each day of the intervention. Each packet contained the sugar for one cup of coffee and was labeled with the date to use it. The type of sugar and the amount required for each day was determined prior to the session using responses to three items

from the screening (T0) questionnaire. Those items assessed (1) how many separate cups of coffee they typically had in a day ($M = 2.31$, $SD = 0.78$, $Range = 1.0 – 5.0$); (2) how many teaspoons or packets of sugar they usually add to their cup of coffee ($M = 2.17$, $SD = 1.26$, $Range = 0.5 – 9.0$); and (3) the type of sugar they usually add to their coffee (85% used some type of sugar, the rest used a sugar substitute). Ambiguous or implausible responses were clarified over email.

Condition 3: Mindfulness Training. Participants were given a brief version of one component (mindfully eating a raisin) of the standardized Mindfulness-Based Eating Awareness Training (MB-EAT) (Kristeller et al., 2013; Papies et al., 2011), adapted for coffee consumption. In addition, a coffee professional gave a 10-minute training on five key features to notice in coffee (flavor, acidity, sweetness, mouth-feel, and aftertaste) to help participants become more mindful of various sensory aspects of coffee. Three different coffees were poured, their five key features were described, and subjects were guided through the mindful "raisin" activity as they tasted each one. The tasting activity involved taking time to slowly and deliberately (1) hold the cup of coffee and notice its warmth, (2) see the steam rise from the cup and the liquid move about, (3) smell the aroma and notice how it makes one feel, (4) place the cup against one's mouth and take a sip, noticing how one moved and prepared to take the sip, (5) take several small sips and further notice new sensations and textures, and (6) reflect on how the experience made you feel. After the training, participants were asked to use those techniques to drink their coffee sugar-free over the next 14 days. To equalize expectations, they were told "this might be challenging, but research shows that if you, for example, stop adding salt to your food and start eating that food mindfully, you will get used to it that way. We are trying this with sugar in coffee."

Intervention Period (T2). Subjects used their strategy for 14 consecutive days following training. After drinking their first cup of coffee each day, participants responded to the questionnaire they had placed on their phone.

Follow-ups (T3,T4,T5). Participants received questionnaires by email on the last day of the 14-day intervention period (T3), and also one-month (T4) and six-months (T5) later. Attrition was low, and equal across conditions (Figure 1).

Primary Measures

Actual Sugar Use. At T1, T4, and T5 sugar-free coffee consumption over the prior month was measured in two ways. One measure was of self-reported frequency (0 = "never" to 4 = "all the time"), and the other was of the percent of all coffees consumed that were sugar-free.

Daily Enjoyment. During the 14-day intervention period (T2), enjoyment of coffee was measured daily after the first cup of coffee with two items (averaged into one overall enjoyment rating). One item asked participants how much they liked the coffee, and the other asked how unpleasant it tasted. Both items used 7-point scales (1 = "Not at All"; 7 = "Very Much"), and unpleasant ratings were reverse coded.

Intention to drink coffee sugar-free. Intentions were assessed at T3, T4, and T5. All items were presented on 7-point scales. At T3 two items were used (and averaged to create an overall intentions score), "how likely are you to continue drinking your coffee sugar-free?", and "I intend to continue drinking my coffee without sugar for the foreseeable future." At T4 and T5, only the second item was asked. Higher scores represent stronger intentions to drink coffee sugar-free.

Daily Attention. Attention was measured each day of the 14-day intervention period (T2) after the first cup of coffee with the item: "How much attention were you paying to the taste and

feel of the coffee as you drank it?" The item used a 7-point scale (1= "Not at All Attentive"; 7= "Very Attentive").

MEQ. The awareness subscale of the Mindfulness Eating Questionnaire (MEQ; Framson et al., 2009) was adapted for coffee drinking, and administered at T1,T3, T4, and T5. It measures the extent to which individuals are aware of their internal states and senses while drinking coffee. The scale has 7 items using 4-point scales (1 = "never/rarely"; 4 = "usually/always"), including "I notice when there are subtle flavors in the coffee I drink."

Software

The computational software, R version 3.3.1 (2016-06-21) and RStudio version 1.0.136 (RStudio Team, 2016), were used for all analyses and figures. Linear mixed effects models were fit using the lmer function in the lmerTest package (Kuznetsova et al., 2016). Maximum Likelihood Estimation (MLE) was used for all models.

Results

Results are reported for all pre-registered analyses, and all analyses reported here were pre-registered unless stated otherwise. See Table 1 for means and standard deviations of each measure.

[Insert Table 1]

Behavior: Sugar Use. We hypothesized that one month and six months after the intervention ended, participants in the mindfulness and gradual reduction conditions would be more likely to consume their coffee sugar-free than participants in the control condition. According to our pre-registered one-tailed t-tests, mindfulness participants consumed their coffee

sugar-free more frequently than control participants one month after the intervention ended (M_m = 2.89, M_c = 2.25, 95% CI [.168, ∞], $t(66) = 2.27$, $p = .013$, $d = .56$), and this difference remained marginally significant six months after the intervention (M_m = 3.03, M_c = 2.62, 95% CI [-.071, ∞], $t(72) = 1.42$, $p = .080$, $d = .34$; Figure 2, left panel).

[Insert Figure 2]

They also consumed a marginally greater percentage of their coffee sugar-free one month later (M_m = 69.49, M_c = 55.84, 95% CI [-.304, ∞], $t(66) = 1.63$, $p = .054$, $d = .40$) and six months later (M_m = 72.18, M_c = 60.71, 95% CI [-2.52, ∞], $t(72) = 1.37$, $p = .088$, $d = .32$; Figure 2, right panel). Contrary to our predictions, we did not find these effects with participants in the gradual reduction condition compared to the control condition for either measure, at either time point (frequency and percent at one-month, *p's* = .701 and .796, and six-months, *p's* = .919 and .855). To explore these same effects longitudinally (which we neglected to pre-register), we also fit linear mixed effects models interacting condition and time (reported at osf.io/yq52s, see analysis script). Results are consistent with the pre-registered effects reported above—mindfulness participants increased sugar-free consumption more than did control participants.

Daily Enjoyment. We hypothesized that both interventions would produce increases in enjoyment of sugar-free coffee compared to the control condition. As pre-registered (see osf.io/yq52s for model fit details), we first fit a linear mixed effects model with random intercept and slope to examine changes in enjoyment of sugar-free coffee over the 14-day intervention period between mindfulness and control participants, excluding gradual reduction participants because they did not have sugar-free coffee until days 12-14. Counter to our hypothesis, there

was not a significant difference between mindfulness and control participants in their overall level of enjoyment (β= 0.095, $p = 0.658$), nor was there a more rapid increase in enjoyment over time for mindfulness participants compared to control participants (β= 0.007, $p = 0.738$, see Figure 3).

[Insert Figure 3]

Participants in both conditions experienced a significant increase in their enjoyment for sugar-free coffee (β= 0.071, $p < 0.0001$), even after controlling for baseline enjoyment of it (β= 0.071, $p < 0.0001$).

The second pre-registered test of enjoyment included participants in the gradual reduction condition, and involved only the time points in which they consumed coffee without sugar (intervention days 12-14). Unexpectedly, participants in this condition enjoyed sugar-free coffee *less* than participants in the control condition, according to independent samples t-tests (M_r = 4.56, M_c = 5.33, 95% CI [-1.25, -.298], $t(83) = -3.326$, $p = .002$), and their enjoyment decreased from baseline to days 12-14, relative to control participants' increase in enjoyment over that same period ($M_{2r} - M_{1r} = -.262$, $M_{2c} - M_{1c} = .860$, 95% CI [-1.68, -.563], $t(83) = -4.046$, $p = .0001$). For participants in the gradual reduction condition, enjoyment steadily declined as sugar was gradually removed from their coffee (Figure 3).

Intentions. We hypothesized that participants in the two interventions would have stronger intentions to continue drinking sugar-free coffee in the future than participants in the control condition. Although intentions were high for both mindfulness and control participants, mindfulness participants only reported significantly stronger intentions than control participants at the one-month (T4) follow-up (M_m = 5.66, M_c = 4.91, 95% CI [.108, ∞], $t(66) = 1.953$, p =

.028, d = .481), and not on the 14th intervention day (T3), or 6 months (T5) after the intervention (p's = .397 and .177). There were no differences between gradual reduction and control participants in intentions at any of the follow-ups (p = .858, p = .668, and p = .882 for T3, T4, and T5 respectively).

Attention. As hypothesized, mindfulness participants paid closer attention to the taste and feel of their coffee when they drank it than control subjects did. This was tested with a linear mixed effects model with random intercept and slope (β= .543, p = .022, see Figure 4, Supplement), using the ratings of attention that participants reported after consuming their first cup of coffee each day.

Mindful Awareness (MEQ.) We predicted that participants in the mindfulness condition would show a larger increase in mindful awareness than control participants. Both mindfulness and control participants significantly increased in mindful awareness of coffee from the beginning to the end of the study (β= .070, p = .019 for the main effect of time across these conditions), but unexpectedly, participants in the mindfulness condition did not increase at a faster rate (T3 minus T1; $M_{3m} - M_{1m}$ = .118, $M_{3c} - M_{1c}$= .132, 95% CI [-.176, ∞], $t(78)$ = -.144, p = .557).

Discussion

Reducing the amount of sugar used in coffee is a sensible and healthy dietary change, and as shown here, participants in all three of our brief study conditions were able to make this change and sustain it for six months, although in varying amounts. The most effective approach was the mindfulness intervention, which trained individuals to consume coffee with close

attention and focus, but repeated exposure alone was nearly as effective.

We estimated the number of calories participants "saved" solely from sugar over the course of the study from their pre-intervention reports of the number of cups of coffee they consumed per day and the amount of sugar they used per cup, and their final reported percentage of cups consumed sugar-free. Participants in the mindfulness condition consumed about 53 fewer calories per day in the six months after the intervention than they did before the intervention, whereas control participants consumed 36 fewer calories per day, and gradual reduction participants consumed 21 fewer calories per day.

The changes in sugar usage generally favoring the mindful intervention over the control condition were not entirely reflected in the other outcomes we measured, primarily because repeated exposure alone led to larger effects than we expected. Participants in the control and mindfulness conditions experienced a significant and substantial increase in their daily enjoyment for sugar-free coffee over time. They also had significant increases in intentions to consume their coffee sugar-free, and in their reports of overall mindfulness about coffee, but the mindfulness intervention did not lead to changes beyond those found in the control group.

Mindfulness participants did, however, pay closer attention to the taste and feel of their coffee when they drank it than control subjects did. This variable was measured daily, immediately after drinking coffee, and may have been more sensitive to attentional differences than the broader mindful awareness measure, which participants completed just at the beginning and end of the intervention.

The second intervention we tested, gradually reducing the amount of sugar used, was not effective in maintaining enjoyment. As less sugar was used in their coffee over 14 days, the less these participants enjoyed it. This finding contradicted our hypothesis, as well as prior research

with salt (Bobowski et al., 2014). In that research, however, salt was reduced in smaller amounts (in 12 increments instead of our six) over a longer period of time (16 weeks compared to our two). It is possible that our reduction was too big and too quick to be effective.

Our results suggest that people may be better off giving up sugar in their coffee all at once, rather than gradually, which does not appear to fit with common suggestions for adopting a sugar-free lifestyle. According to the first ten links from an internet search for "how to reduce sugar in your diet," six websites recommended gradually reducing sugar and none recommended quitting abruptly (plus two recommended something in between these two strategies and two recommended neither.

The primary limitation of these results is that participants were selected partly because they reported on the screening questionnaire that they were willing to reduce the sugar in their coffee for two weeks, so they may have been more motivated to do so than other coffee drinkers. We may not find such encouraging results with a less motivated population, such as individuals who were instructed by other people (such as a physician) to reduce sugar in their diet (although a doctor's orders or threat of disease may also be motivating).

Another limitation is that the mindfulness intervention was made up of two distinct components, and it is not possible to assess which aspect of it was potent. It is possible that training in mindful consumption of coffee on its own would lead to the effects found here, or that training in detecting salient features of coffee on its own would lead to these effects. Future research will be needed to test the separate and combined effects of these two components.

Consuming excess sugar has been linked to weight gain and increased risk for diabetes and cardiovascular disease. Helping people reduce their sugar intake is an important goal for promoting health, and removing sugar from coffee appears to be a change that people can

accomplish without time-consuming intervention or instruction.

Acknowledgements

We thank Timothy Chapdelaine for designing and implementing the coffee training and tasting component of the mindfulness intervention. We also thank Lucy Zhou for managing the study, and the research assistants in the Mann Lab for their dedicated efforts packing sugar. See our public project page (osf.io/yq52s) for pre-registration, dataset, analysis script, intervention materials, and more.

Funding Acknowledgement

This project was funded by a grant from the Engdahl Family Foundation through the Department of Psychology at the University of Minnesota.

Declaration of Conflicting Interests

The Authors declare that there is no conflict of interest.

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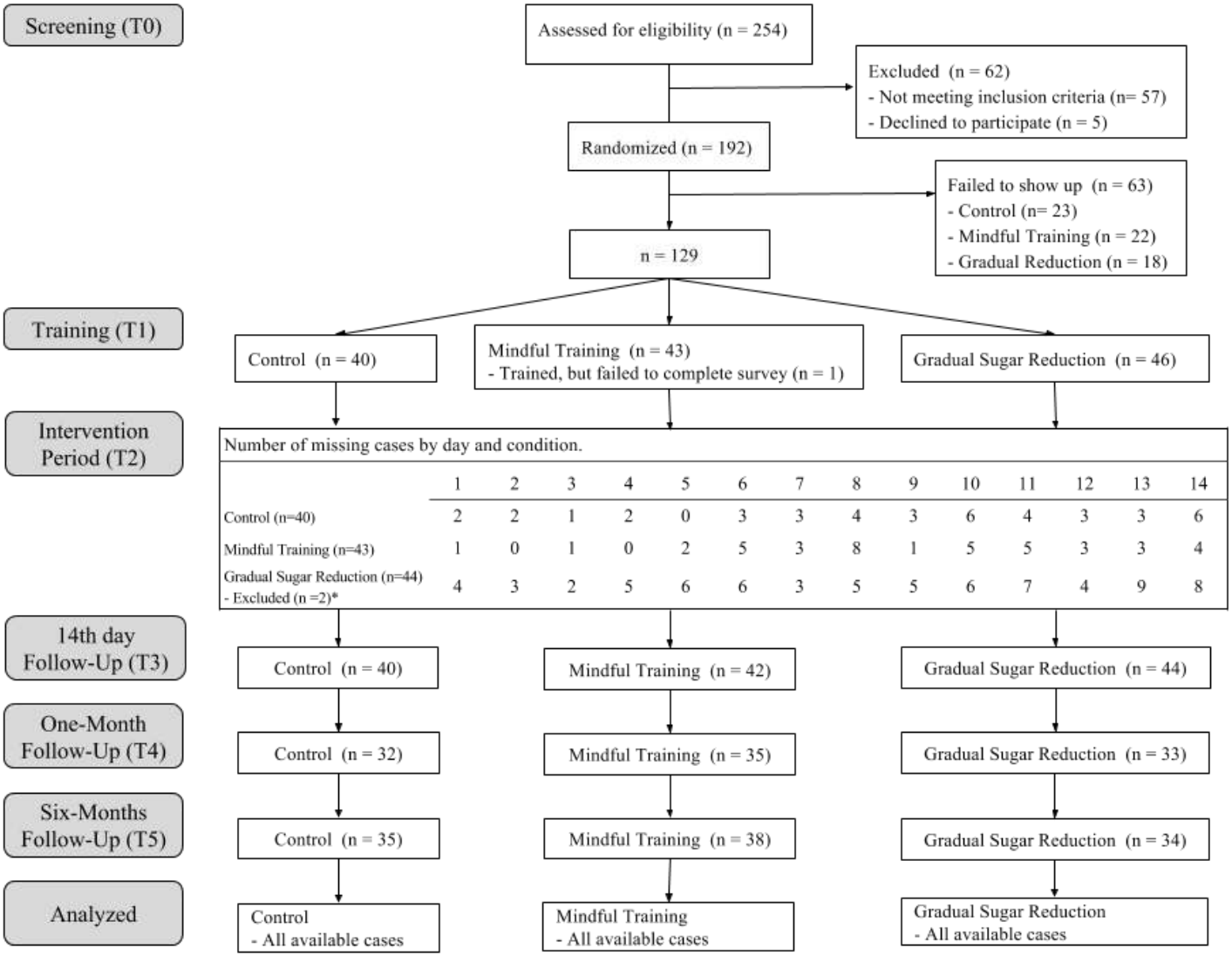
Table 1. Means (standard deviations) for dependent measures by condition and time.

	Time				
	T1	T2*	T3	T4	T5
Enjoyment of Sugar-Free Coffee					
Control	4.45 (1.11)	5.33 (1.02)	-	-	-
Mindful	4.77 (1.65)	5.42 (0.98)	-	-	-
Reduction	4.75 (1.32)	4.56 (1.17)	-	-	-
Frequency of Sugar-Free Consumption					
Control	1.43 (0.90)	-	-	2.25 (1.14)	2.62 (1.26)
Mindful	1.05 (1.15)	-	-	2.89 (1.16)	3.03 (1.17)
Reduction	1.50 (1.02)	-	-	2.09 (1.28)	2.15 (1.44)
Percent of Cups Consumed Sugar-Free					
Control	17.65 (17.05)	-	-	55.84 (34.79)	60.71 (36.22)
Mindful	13.55 (22.48)	-	-	69.49 (33.47)	72.18 (34.80)
Reduction	18.66 (21.47)	-	-	48.09 (40.20)	50.76 (39.85)
Mindful Awareness (MEQ)					
Control	2.62 (0.55)	-	2.76 (0.58)	2.72 (0.60)	2.79 (0.67)
Mindful	2.85 (0.49)	-	2.95 (0.55)	3.01 (0.62)	2.91 (0.64)
Reduction	2.82 (0.51)	-	2.77 (0.46)	2.78 (0.51)	2.87 (0.51)
Intentions to Consume Sugar-Free Coffee					
Control	-	-	5.23 (1.49)	4.91 (1.77)	5.26 (1.96)
Mindful	-	-	5.33 (1.65)	5.66 (1.33)	5.68 (1.85)
Reduction	-	-	4.77 (2.02)	4.70 (2.10)	4.64 (2.32)

*Mean of days 12-14 of intervention period



* The pre-registered exclusion rule is that subjects missing data on 7 or more of the 14 intervention days on the measure of enjoyment will be excluded from all analyses.

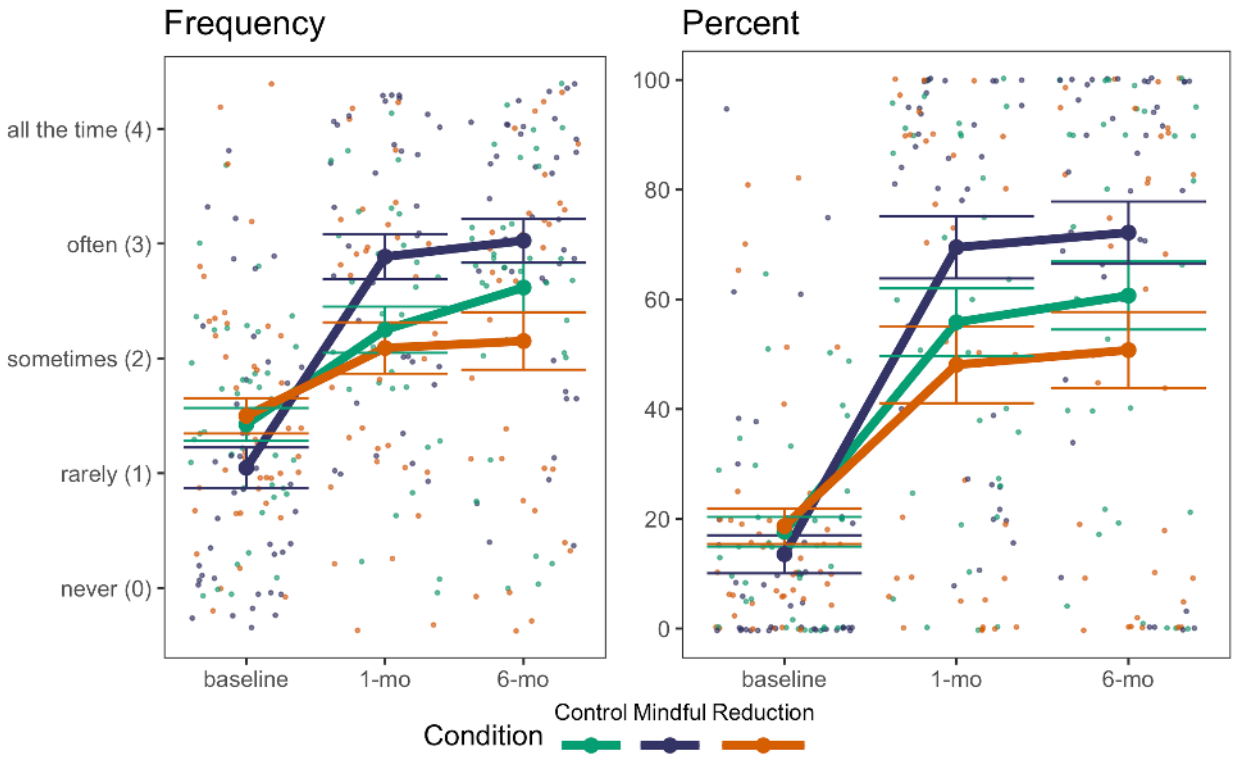


Figure 2. Sugar-use by condition at baseline (before the intervention), one month after the intervention ended, and six months after the intervention ended. The left panel shows the frequency of consumption of sugar-free coffee. The right panel shows the percent of cups of coffee that were consumed sugar-free. Mean and standard error are depicted at each time point. All responses are plotted.

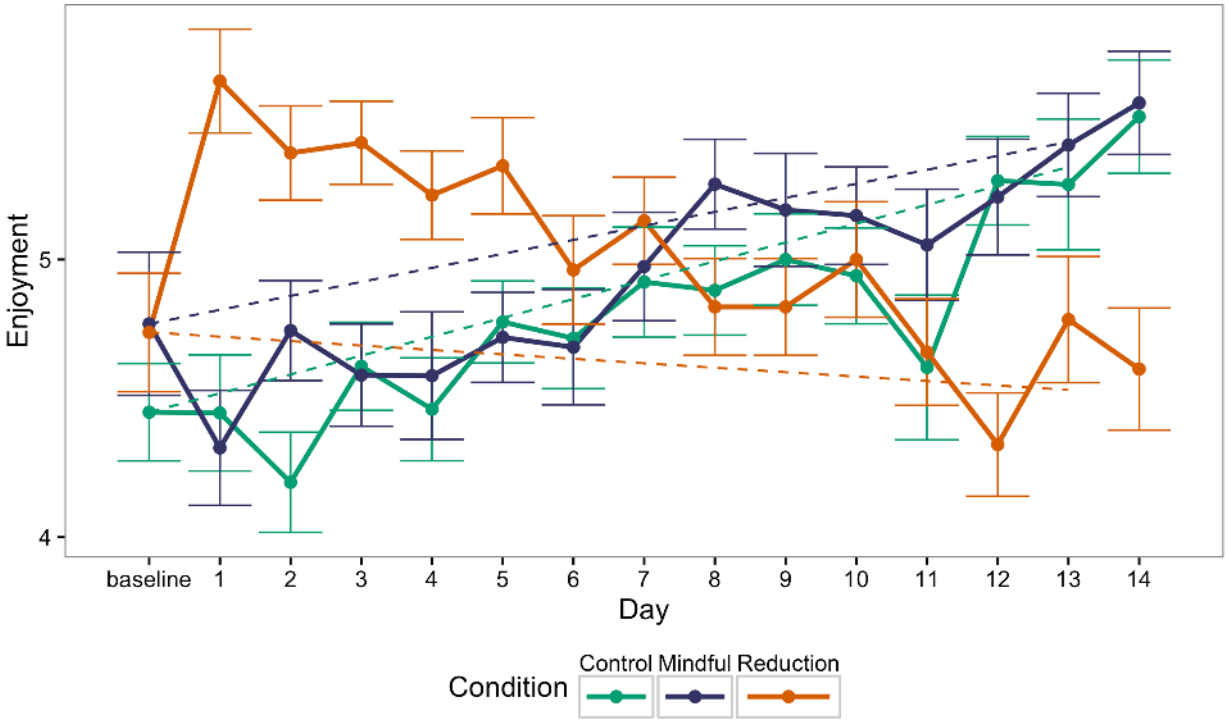


Figure 3. Enjoyment of the first cup of coffee consumed each day during the 14-day intervention period, rated immediately after consumption, by condition. Mean and standard error are depicted at each time point. The gradual reduction condition rated sugar-free coffee only at baseline, and days 12-14. Days 1 to 11 their sugar is being reduced by 1/6 of their starting amount every two days. Mindfulness and control conditions rated sugar-free coffee at all time points. The colored dashed lines represent change slopes from baseline to the mean of days 12-14.