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Coffee cues elevate arousal and reduce level of construal

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ABSTRACT

Coffee and tea are two beverages commonly-consumed around the world. Therefore, there is much research regarding their physiological effects. However, less is known about their psychological meanings. Derived from a predicted lay association between coffee and arousal, we posit that exposure to coffee-related cues should increase arousal, even in the absence of actual ingestion, relative to exposure to tea-related cues. We further suggest that higher arousal levels should facilitate a concrete level of mental construal as conceptualized by Construal Level Theory. In four experiments, we find that coffee cues prompted participants to see temporal distances as shorter and to think in more concrete, precise terms. Both subjective and physiological arousal explain the effects. We situate our work in the literature that connects food and beverage to cognition or decision-making. We also discuss the applied relevance of our results as coffee and tea are among the most prevalent beverages globally.

1. Introduction

Coffee is the 4th-most consumed beverage in the world today, while tea ranks 2nd (PR Web, 2011). Similar to many other foods and beverages (Chan & Zlatevska, 2019a, 2019b; Rick & Schweitzer, 2012; Rozin, Hormes, Faith, & Wansink, 2012), coffee and tea likely have psychological meanings (i.e., lay associations). We consider what coffee and tea might mean to people and the implications of these meanings.

Surely, the popularity of coffee and tea differs by region. Coffee is more common in Western cultures, and tea is more common in Eastern cultures. Thus, from the outset, we set as our focus the meaning of coffee and tea primarily to individuals from Western cultures (e.g., brewed coffee and black or green tea). We also recognize that both beverages can take on different forms (e.g., espressos and hallucinogenic mushroom tea) even within Western cultures. Indeed, there exist many types of coffee and tea, and so our focus is primarily on “black” coffee and black/green tea, which are the more popular forms of these two beverages in Western societies.

In brief, we hypothesize that merely being exposed to cues related to coffee might increase arousal, compared to exposure to tea-related cues. We test the possibility that such arousal elicited from coffee cues alone might facilitate a concrete level of mental construal by directing people to see temporal distances as shorter and to score lower on measures of construal level, consistent with Construal Level Theory (CLT; Trope & Liberman, 2000, 2010). If so, then we suggest that coffee might not simply increase arousal via its physiological make-up and ingestion but it can do so via mere cognitive processes. It also implies possible diffuse effects on thinking via shifts in level of mental construal.

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1.1. Coffee, Caffeine, and arousal

From a chemical standpoint, coffee on average has 150 mg of caffeine per cup while tea has about 40 mg per cup. While the caffeine from coffee and tea increases the drinker's alertness and attention by boosting the automatic nervous system (Quinlan, Lane, & Aspinall, 1997), the arousing effects are more pronounced and occur quicker for coffee by providing the drinker with an immediate physiological "lift." The arousal from coffee is useful in reducing fatigue and overcoming dullness in situations demanding orientation to detail and in improving attention on complex tasks by helping the drinker maintain focus throughout extended periods of time (Smith, Clark, & Gallagher, 1999).

The possible connection between drinking coffee and arousal is particularly salient in Western cultures, with prototypes contrasting a business executive holding a cup of coffee while rushing to a meeting and an afternoon break accompanied by a cup of tea. Weinberg and Bealer (2001) summarized various differences between coffee and tea drinkers: Coffee drinkers are vivacious and extroverted while tea drinkers are shy and introverted, at least relative to one another. Coffee is associated with the "yang" and active energy, whereas tea is associated with the "yin" and stored energy. There are also perceptions of the coffee drinker as ambitious and rigidly-organized while the tea drinker is calm, relaxed, and less status-oriented (Hannam, 1997). A study in the *Daily Mail* (2013) likewise noted that coffee drinkers, at least in the United Kingdom, earn on average £2160 more than tea drinkers, which the authors argued is because coffee drinkers may be more persistent or less laid-back. These are only anecdotal observations but they nevertheless highlight a prominent lay theory that coffee is an arousing beverage in Western societies.

Arousal is the physical state of increasing activation that can vary from drowsiness to excitement (Mehrabian & Russell, 1974). There are both physiological and cognitive effects of arousal. Physiologically, arousal increases heart rates and electrodermal activity levels (Fowles, 1980). Cognitively, arousal changes attention, thought, and performance (Gorn, Pham, & Sin, 2001; Kever, Grynberg, & Vermeulen, 2017; Smith et al., 1999). Arousal is one dimension of affect; valence is the other (Watson, Clark, & Tellegen, 1988). Thus, drinking caffeinated coffee can be said to increase arousal, with changes occurring both physiologically and cognitively. Even low doses of caffeine (< 200 mg) can improve performance on simpler reaction tasks, increase alertness, and decrease drowsiness or fatigue (Quinlan et al., 1997).

1.2. Arousal from Coffee-Related cues

Is it possible for mere exposure to coffee-related cues to elicit arousal, even without actual ingestion of the beverage, more so than exposure to tea-related cues? In the psychology literature, at least under some circumstances and temporarily, environmental cues can trigger thoughts and behaviors related to those cues. Jordano and Touron (2017) reported that subliminal exposure to performance-related concerns (e.g., math-gender stereotype threat) decreases task performance. Sidarus, Chambon, and Haggard (2013) found that activating the mere concept of action can lead to feelings of control given mental links between action and control. Related to the food domain, exposure to the McDonald's logo can lead to impatience (Zhong & DeVoe, 2010). Impatience is triggered because McDonald's is often consumed when time is short. Thus, the McDonald's cue primes not just knowledge but behavior associated with the construct. There is often a mental overlap in semantic and behavioral nodes, so activating one construct may automatically activate the linked one, with the strength of the lay association likely modulating the effect (Anaki & Henik, 2003; Hutchison, 2003).

Thus, as long as individuals *see* a connection between coffee and arousal, whatever its origin may be, mere exposure to coffee-related cues, more than exposure to tea-related ones, might trigger arousal in and of themselves sans ingestion. Indeed, it is possible for arousal to be elicited via environmental cues. For example, anger and aggression can be elicited from merely being in rooms filled with weapons (Berkowitz & Lepage, 1967). Related to coffee, our hypothesizing that exposure to coffee cues can lead to arousal has support. Smelling coffee gives rise to the beverage's psychoactive, arousing effects (Knasko, 1995). This result was explained by coffee smells producing the same tangible changes in the human body as actual ingestion, but an alternative remains, with odors triggering related beliefs (Stevenson & Boakes, 2003) such as smells of pine trees cuing images linked to Christmas (Chu & Downes, 2000). This literature has not been framed around the phenomenon of conceptual priming, although they all similarly draw from the activation of one construct and how a mental knowledge structure can trigger related constructs while relying on a standard paired-associate learning paradigm where odors or other stimuli are associated with a target and the efficacy of each cue type is compared in a test of cued recall (Herz & Cupchik, 1995).

The possibility that arousal might be cued merely by coffee-related ideas and images is also plausible from the lens of classical conditioning (Siegel & Ramos, 2002). Priming has been used as an account for conditioning effects (Webb, Hendricks, & Brandon, 2007), with repeated pairings between stimuli capable of eliciting conditioned responses. For example, with smokers, the presentation of smoking-related stimuli can increase heart rates (Carter & Tiffany, 2001). The effects of caffeine from coffee could likely be conditioned in a related way (Price, Finniss, & Benedetti, 2008). Our work goes beyond this by studying coffee-related cues and not ingestion of coffee (which could lead to expectancy effects and produce effects via a different process from the route we posit) but it nonetheless informs the possibility that exposure to coffee cues without ingestion may increase arousal.

1.3. Downstream consequences on construal level

We leverage this predicted effect—whereby exposure to coffee-related cues might increase arousal—to further test the possibility that arousal can induce a lower level of mental construal. We anchor our prediction to Construal Level Theory (CLT; Trope & Liberman, 2000, 2010), which adopts a dual-process model of cognition. Construal, in CLT terms, refers to how people process information related to and mentally represent stimuli. The term "construal" is used in other academic fields, and the CLT

conceptualization is largely similar. In linguistics, Langacker (2008) defined the term construal as a "manifest ability to conceive and portray the same situation in alternate ways" (p. 43). Compare "John hit the wall with a stick" to "John hit a stick against the wall." Both refer to the same event, but with unique emphases depending on how the audience comprehends or "construes" it. CLT's conceptualization is most akin to the *specificity* dimension of linguistic construal in that both refer to the "level of precision and detail at which a situation is characterized" (Langacker, 2008, p. 55). This linguistic conceptualization mainly focuses on how people use grammar or sentence structure to "construe" an event. CLT's conceptualization often focuses on "construal" as a mindset via which to interpret new information.

First, as related to CLT's positing of construal in terms of a cognitive mindset, the construal of an event can be low or high, with both vantage points representing the same event but at different specificity levels. Processing information at a *concrete* or low level of construal leads individuals to pay greater attention to narrow and discrete details. Conversely, processing information at an *abstract* or higher level of construal leads to a focus on broad, superordinate generalities. As related to coffee and tea, since coffee might elicit arousal merely via images and cues related to coffee, this can have a downstream consequence on construal level by lowering it to a more concrete level, at least relative to tea. We emphasize that this does not mean that coffee and tea cues would lead people to focus on *different* stimuli, just that they would construe the same thing with different levels of specificity.

Why might arousal facilitate concrete thinking? One determinant of construal level is psychological distance—thinking about target objects that are either far from or near to one's immediate and egocentric experiences (Trope & Liberman, 2010). Psychological distance can take many forms (e.g., happening in the present vs. future, being geographically close vs. far away), but regardless of the type of distance, the feeling of closeness elicits a concrete level of mental construal. For example, concrete construals (immersed in visceral, detailed experience) foster emotional intensity (Maglio & Feder, 2017), creating a sense of psychological closeness (vs. distance) via a field (vs. an observer) perspective in the retrieval of memories (Gu & Tse, 2016). Another possibility arises from how arousal's narrowed perceptual attention can drive attention conceptually (Neill & Westberry, 1987). As an example, looking at the Gestalt of maps can generate broader thinking on an unrelated creativity task (Friedman, Fishbach, Förster, & Werth, 2003).

To further motivate the possible effect of arousal on concrete construal, consider arousal's effects. Arousal affects information processing by directing greater attention toward tasks immediately "at hand" in the present moment (Gorn et al., 2001; Lieberman, Wurtman, Emde, Roberts, & Coviella, 1987; Quinlan et al., 1997), which suggests that arousal might reduce the felt psychological distance between individuals and targets under consideration and result in more discrete attention paid to matters at hand. Arousal gives the immediate environment priority. This zoomed-in perspective means that individuals evaluate things with greater precision, and in so doing, represent them concretely. Though arousal often originates from one particular source, its influences are diffuse and non-specific (Zillmann, 1971). The higher arousal that might come from coffee cues might reduce the felt distance of and lower construals for not only stimuli related to coffee (the originating trigger for arousal) but independent considerations in other domains as well.

In sum, we propose that exposure to coffee cues may increase arousal that in turn will prompt more concrete-level processing. This hypothesis hinges upon a lay association between coffee and arousal whereby exposure to coffee cues activates both physiological and cognitive outcomes of arousal (e.g., increased heart rate and narrowed attention). Further, because arousal likely reduces felt psychological distance and increases attention, arousal via exposure to coffee cues should produce a lower construal level. We test these predictions in four experiments using self-reported and physiological measures of arousal and different established construal measures. In each experiment, we seek to maximize power by collecting as many responses as possible but as limited by the data collection method.

2. Experiment 1: cross-cultural differences in coffee's meaning

We propose that individuals likely associate coffee and arousal, so exposure to coffee-related cues should facilitate concrete thinking, and the strength of the link between coffee and arousal should moderate the effect. The effect of coffee cues on concrete mental construal should be stronger for those with a stronger link between coffee and arousal.

Given that the coffee-arousal linkage is strong in Western cultures, our posited effect might only arise for individuals from Western cultures (more than those from Eastern cultures). We recruited undergraduates from two cultural backgrounds: Western (America, Canada, and Europe) and Eastern (China, Japan, and Korea). Those from a Western background should show strong associations between coffee and arousal, thus coffee-related cues should reduce psychological distance; our participants from Eastern cultures only recently emigrated to either America or Canada and so should they have weak associations between coffee and arousal owing to the fact that they grew up in non-coffee-dominant (if not tea-dominant) areas. Our subsequent studies will unpack the relationship between coffee cues and arousal; this first experiment sought only to establish the basic connection from coffee to distance. Thus, we investigate the possible impact of coffee-related cues on distance, predicting that coffee cues would reduce psychological distance (in the form of temporal distance) as a function of culture.

2.1. Participants

We recruited undergraduate students from two large public, research-intensive universities, one American and one Canadian, both of which have a mixture of Western and Eastern students. For the latter category, we specifically recruited undergraduates from China, Japan, and Korea who only moved to North America within the previous three years, as students from Eastern cultures but raised in North American society might have just as strong of an exposure to (and, thus, associations for) coffee as Western students.

Our dataset included a total of 113 students with a mean age of 19.71 years old (*S.D.* = 1.34 years old). There were 48 from

Western backgrounds (M_{age} = 19.34 years old; *S.D.* = 1.43 years old) and 65 from Eastern backgrounds (M_{age} = 20.0 years old; *S.D.* = 1.31 years old). A *t*-test revealed no difference in age between the two groups/schools, $t(1\ 1\ 1) = 1.47$, $p = .14$, $d = 0.27$ (95% C.I.: −0.09, 0.65). They were recruited from their universities' subject pools. There was no difference in the proportion of men and women between the two groups or schools, $\chi^2(1) = 1.19$, $p = .27$, $\varphi = 0.09$. The sample size of 113 was limited by the constraints of our subject pools and restriction to two particular cultural groups, but according to a sensitivity analysis using G*Power, it could identify an effect size of $d = 0.62$ at the alpha = 0.05 and power = 0.80 levels with $df = 3$ and 4 groups.

2.2. Method

Participants completed the study inside the behavioral lab on the provided computers, and the experimenter was blind to condition.

Using a temporal distance methodology that we adapted from Spassova and Lee (2013), participants first listed three activities that they planned to do in the future. Then, via random assignment, they were exposed to either coffee or tea cues. Here, we informed students that a multi-national beverage company called "Arisokraft" was planning to introduce a new brand of either coffee beans or tea leaves to be sold across North America. Aristokraft was searching for new slogans for the product, and thus it was asking participants to generate up to five slogans for advertising purposes; they were free to generate fewer than five. Afterward, they saw the same three activities that they had listed earlier. For each one, students reported when they planned to engage in it ($\alpha = 0.35$).[1] For example, participants could say "8 days" or "8 years" or any other timeframe in a unit of their preference. Lower construals should decrease the timeframe in which students would expect to engage in the activities. We chose timing as it is often studied in construal level research (Trope & Liberman, 2010) and also because one type of subjective closeness or distance is interchangeable with another (Maglio, Trope, & Liberman, 2013).

During debriefing, no participants indicated any suspicion about the study.

2.3. Results

Examples of the activities students listed included "going on vacation," "going to the dentist," and "start studying for finals," among others. For each one, we converted the timing estimates into days (e.g., "in two weeks" was converted to 14 days) in order to compare across all students in all conditions (consistent with Spassova & Lee, 2013). Since the Cronbach's alpha across the three timeframes (standardized) was not high ($\alpha = 0.35$), which is not surprising given that the activities were different and thus there need not be a conceptual overlap with each other, we decided to conduct three separate factorial between-group 2 (Caucasian, East Asian) × 2 (coffee, tea) ANOVAs to analyze each activity separately and in the interest of completeness in data reporting; we present a collapsed analysis subsequently. The analyses are reported in days, which Table 1 presents. For each activity, there was no main effect of culture or of beverage, $ts < 1$, $ps > 0.11$, $ds < 0.18$ (95% C.I.: −0.18, 0.55).

For the first activity, the two-way interaction was insignificant, $F(1, 106) = 1.98$, $p = .16$ $p = .15$, $\eta^2 = 0.01$. For the second, the two-way interaction was significant, $F(1, 106) = 4.50$, $p = .04$, $\eta^2 = 0.04$. For Westerners, coffee cues reduced time frames ($M = 6.00$ days, *S.D.* = 8.98; $n = 22$) compared to tea cues ($M = 15.00$ days, *S.D.* = 23.35 days; $n = 26$), though the effect was only marginally significant, $F(1, 44) = 3.25$, $p = .08$, $d = 0.54$ (95% C.I.: −0.05, 1.14). Easterners showed no difference between the coffee ($M = 17.07$ days, *S.D.* = 20.98; $n = 30$) and tea conditions ($M = 12.26$ days, *S.D.* = 14.52; $n = 35$), $F(1, 61) = 1.16$, $p = .28$, $d = 0.27$ (95% C.I.: −0.22, 0.88). For the third activity, the interaction was significant, $F(1, 106) = 6.72$, $p = .01$, $\eta^2 = 0.06$. For Westerners, coffee cues reduced the expected timeframe ($M = 6.31$ days, *S.D.* = 10.95) compared to tea cues ($M = 32.78$ days, *S.D.* = 50.86), $F(1, 44) = 6.68$, $p = .01$, $d = 0.77$ (95% C.I.: 0.16, 1.39). Easterners again showed no difference in timeframes between coffee ($M = 34.73$ days, *S.D.* = 59.46) and tea cues ($M = 29.34$ days, *S.D.* = 63.70), $F(1, 61) = 0.12$, $p = .72$, $d = 0.08$ (95% C.I.: −0.41, 0.55).

The large variance in the standard deviations is not unreasonable given that students named future activities that could happen anytime (from one day in the future to several years) and they came up with three of five activities themselves. To reduce variance and to show that coffee cues reduced the timeframe for Western students across all activities, we *Z*-scored the expected timeframes for each activity, took the average across them ($\alpha = 0.35$), and conducted an identical factorial between-group analysis of variance. There was no main effect of culture or beverage, $Fs(1, 106) < 0.98$, $ps > 0.34$, $d = 0.19$ (95% C.I.: −0.18, 0.57), but the two-way interaction across the factors was significant, $F(1, 106) = 9.51$, $p = .003$, $\eta^2 = 0.08$. For those from Western backgrounds, exposure to coffee-related cues reduced time frames ($M = -0.25$, *S.D.* = 0.23) relative to tea cues ($M = 0.02$, *S.D.* = 0.52), $F(1, 44) = 6.20$, $p = .02$, $d = 0.75$ (95% C.I.: 0.13, 1.36). There was no difference in time frames between the coffee ($M = 0.17$, *S.D.* = 0.65) and tea cues ($M = 0.05$, *S.D.* = 1.03) for participants from Eastern cultures, $F(1, 63) = 0.30$, $p = .58$, $d = 0.13$ (95% C.I.: −0.35, 0.63). Fig. 1 offers the *Z*-scored results.

[1] As an example, a student might initially write down "see a dentist" as one activity that they planned to engage in. After having written three such activities, they then received the coffee or tea manipulation. Afterwards, we presented them with the same activities they wrote earlier, one at a time (e.g., "see a dentist"), and asked them *when* they would in fact do each activity (e.g., when they would see a dentist) in sequential order. This was an open-ended response and they could answer in minutes, hours, days, months, or years.

Table 1
Experiment 1: participants' planned activities in days.

	Western background		Eastern background	
Activity	Coffee	Tea	Coffee	Tea
Activity 1	5.45 (22.12)	8.43 (9.98)	14.12 (18.45)	7.45 (14.11)
Activity 2	6.99 (8.98)*	15.00 (23.35)*	17.07 (20.98)[a]	12.26 (14.52)[a]
Activity 3	6.31 (10.95)*	32.78 (50.86) *	34.73 (59.46)	29.34 (63.70)

Time frames are presented in days. Numbers in parentheses present the standard deviations.
* Indicates that the difference between the coffee and tea cues were significant for Activities 2 and 3 separately, $p < .05$.
[a] Indicates that the difference between the coffee and tea cues were significant marginally, $p < .10$.

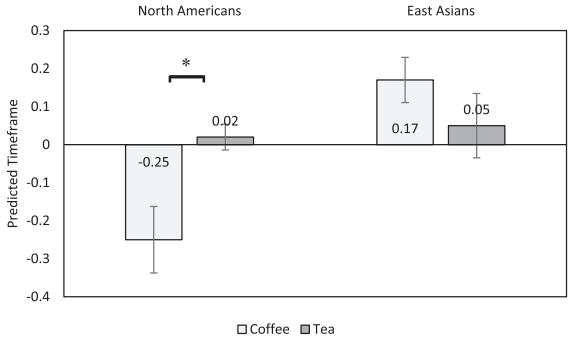

Fig. 1. Experiment 1: Interactive effect of culture and beverage cue on predicted time. Standard error bars presented. $^{*}p < .05$.

2.4. Discussion

These findings provide evidence that exposure to coffee cues can reduce temporal psychological distance. Because psychological distance is likely an upstream determinant of construal level (Trope & Liberman, 2010), Experiment 1 provides initial evidence that coffee cues might affect construal, without actual ingestion, but only among individuals for whom a strong lay association exists between coffee and arousal (i.e., Westerners but not Easterners).

3. Experiment 2: self-reported arousal

Having shown that coffee cues lead people to see things as psychologically closer in terms of temporal distance, we now turn to our hypothesis that coffee cues might decrease self-reported arousal and decrease construal to a concrete level. We used an established measure of construal, allowing us to assess it directly.

3.1. Participants

We recruited participants from Mechanical Turk ($N = 55$). The mean age of our sample was 32.46 years old ($S.D. = 9.76$ years old). There were 31 men and 24 women in all. We based our sample size on the effect size of $d = 0.75$ that we obtained in Experiment 1 for those from Western backgrounds. Setting a desired effect size of $d = 0.75$ at the alpha = 0.05 and power = 0.80 levels, an *a priori* analysis calculated using G*Power indicated that a sample size of 46 was necessary. Because nine participants did not enter the correct password (but they did answer the study's other questions), the online software automatically recruited nine more, thus a total of 55 participants.

3.2. Method

Participants completed the study on their personal computers.

Via random assignment, participants received a coffee or tea manipulation, which differed from Experiment 1. Here, participants read an article summarizing the "many health benefits" of drinking their respective beverage (coffee or tea). The statements were identical, such as by stating that drinking coffee (or tea) increases blood circulation and reduces likelihood of heart attacks. The items were written in a way mimicking health websites (e.g., MayoClinic and LiveStrong). To strengthen the manipulations, participants were then asked to write *other* health benefits of drinking their assigned beverage. Participants spent about 10 min on this writing task. Sample responses on this open-ended writing task included "removes toxins from the body" and "promotes mental health," among others.

Thereafter, we assessed construal level directly by having participants complete an abridged version of the Behavioral

Identification Form (BIF; Vallacher & Wegner, 1989). On this measure, people indicate their choice with respect to categorizing a series of statements in either concrete or abstract terms. For example, with the statement "Making a list," participants choose to categorize it in terms of either the low-level, concrete act of "Writing things down" or the high-level, abstract goal of "Getting organized." Please see Appendix A for the full materials used. We summed the number of high-level choices; thus, higher scores indicate more abstraction. Of note, we adapted an abridged version by including only the 10 statements that Labroo and Patrick (2008) deemed to be affect-neutral, allowing us to indirectly rule out mood effects, given that arousal might be linked with a more positive mood (even though arousal and valence are conceptually distinct; Russell, 1980).

Participants then completed the Perceived Arousal Scale (PAS; Anderson, Deuser, & DeNeve, 1995). Participants reported their current arousal feelings on 24 dimensions such as "excited," "active," and "energetic" as well as "fatigued," "worn out," and "drowsy" (with the latter items reverse-scored), each on 9-point scales (ranging from 1 = "not at all" to 9 = "very much"). We averaged the 24 items on the PAS to generate a single index of arousal ($\alpha = 0.92$); higher scores indicated greater self-reported arousal. Finally, participants indicated their mood on three items using 9-point scales: how bad-good, negative-positive, and sad-happy they felt at the time, on distinct scales ranging from 1 = bad/negative/sad to 9 = good/positive/happy ($\alpha = 0.94$). We wanted to affirm that mood would not explain any possible effects of coffee cues on construal levels.

During debriefing, one participant indicated suspicion about the study. Including or excluding this individual's results did not affect the overall results, and so we kept all responses for the purposes of data analysis.

3.3. Results

We first constructed an index to assess level of construal by summing the number of abstract answers (e.g., "Getting organized" over "Writing things down") that participants chose for each of the 10 items on the BIF, with lower scores indicating more concrete-level thinking. Those who read and wrote about the benefits of coffee scored lower ($M = 5.24$, $S.D. = 2.20$; $n = 27$) than those who read and wrote about the benefits of drinking tea ($M = 7.27$, $S.D. = 2.55$; $n = 28$), $t(53) = 3.12$, $p = .003$, $d = 0.85$ (95% C.I.: 0.29, 1.141).

As detailed above, we also constructed an index of self-reported arousal using the 24 items from the PAS ($\alpha = 0.92$), again with higher scores indicating greater self-reported arousal. Participants who read and wrote about drinking coffee scored higher ($M = 5.72$, $S.D. = 1.28$) than those who read and wrote about the benefits of tea ($M = 5.08$, $S.D. = 0.99$), $t(53) = 2.06$, $p = .04$, $d = 0.56$ (95% C.I.: 0.01, 1.11).

We then conducted a mediation analysis to test whether self-reported arousal would account for the impact of coffee cues on concrete construal. We used Model 4 of Preacher and Hayes (2008) bootstrapping protocols for SPSS 23. Beverage was the independent variable (0 = tea, 1 = coffee), BIF scores were the dependent variable, and PAS was the presumed mediating variable. The indirect effect of coffee cues on construal via self-reported arousal was estimated to lie between −0.92 and −0.03 (5,000 samples, 95% C.I.); the absence of zero in this interval indicates that mediation was statistically reliable. Beverage predicted BIF scores ($\beta = 0.52$, $S.E. = 0.24$, $t = 2.16$, $p < .001$), and it also separately predicted self-reported arousal ($\beta = 0.42$, $S.E. = 0.11$, $t = 3.81$, $p < .001$). Self-reported arousal also predicted BIF scores ($\beta = 0.55$, $S.E. = 0.12$, $t = 4.58$, $p < .001$). However, when both beverage and self-reported arousal were included in a model to predict BIF scores, the effect of beverage weakened ($\beta = 0.24$, $p = .16$, $t = 1.50$, $p = .08$), while the impact of self-reported arousal remained significant ($\beta = 0.44$, $S.E. = 0.14$, $t = 3.14$, $p < .001$).

Lastly, we constructed an index to assess mood by averaging the three mood items ($\alpha = 0.94$). There was no significant difference in mood between participants who wrote about the health benefits of drinking coffee ($M = 4.52$, $S.D. = 1.34$) and the health benefits of drinking tea ($M = 4.23$, $S.D. = 1.54$), $t(53) = 0.74$, $p = .46$, $d = 0.23$ (95% C.I.: −0.30, 0.77).

3.4. Discussion

Coffee cues appear to increase self-reported arousal (as evidenced by high scores on perceived arousal), which subsequently facilitates concrete construal (evidenced by low scores on the BIF). This finding is consistent with our overall theorized effect that coffee cues, without actual ingestion, might increase arousal and shift cognition. We point out that we only measured the BIF, not other measures or downstream consequences. Therefore, we make no claim whether the effects are positive or negative (i.e., beneficial or harmful to well-being).

However, Experiment 2 only documented evidence for our proposed effect on *self-reported* arousal. This is in-line with Thayer (1967; 1978), who argued that self-reported arousal often correlates more highly with physiological measures than physiological measures with each other, making subjective arousal a good test. To determine if coffee cues might increase physiological arousal as well, we next measured heart rates and sought to see whether this would also mediate the link from coffee cues to more concrete levels of mental construal.

4. Experiment 3: physiological arousal

There are numerous ways to measure physiological arousal. One way of doing so is to measure heart rates (Fowles, 1980), with higher heart rates providing a marker of higher arousal (Azarbarzin, Ostrowski, Hanly, & Younes, 2014). Heart rate indices can be more diagnostic than self-reported arousal measures and skin conductance tests because the latter two are susceptible to noteworthy individual differences. Thus, we measure heart rates in this study.

4.1. Participants

We recruited students from upper-level undergraduate management classes ($N = 361$). The mean age was 20.28 years old ($S.D. = 1.35$ years old). There were 198 men and 163 women. They completed this study in a lab setting (in groups of 6–12) in return for course credit. We sought to maximize our use of the subject pool as we did not have to exclude anyone unlike Experiment 1 (based on cultural groups). The final sample was above the 46 that was necessary (same calculations as in Experiment 2). A sensitivity analysis calculated using G*Power indicated that our sample of 361 could test an effect size of $d = 0.26$.

4.2. Method

Participants completed the study inside the behavioral lab on the provided computers, and the experimenter was blind to condition.

Via random assignment, participants received the same coffee or tea manipulation as in Experiment 2. Thereafter, they completed the same measure of construal level as in Experiment 2 (the abridged version of the BIF).

All students were then asked to test a heart rate application for the Android smartphone OS for market research purposes. The experimenter presented each student with his personal smartphone (to reduce confounds inherent to using participants' own devices), which was a Sony Xperia Z5 Compact running Android 6 on which the application "Instant Heart Rate+" by Azumio Inc. was installed. This application assesses heart rate by having individuals put their index fingers over the camera in order to detect subtle changes in skin color, a methodology established as effective in measuring heart rates (Ho et al., 2014; Kwon, Kim, & Park, 2012; Lakens, 2013). Participants placed the index finger of their dominant hand on the smartphone's camera, and heart rates were measured for 20 s in order to produce a heart rate estimate (in pulses per minute) for each individual. Participants either stood still or sat still while performing this task, as it has been shown that walking during the collection of heart rate information on a smartphone may produce greater variance (Sumida, Mizumoto, & Yasumoto, 2013). We chose to use Instant Heart Rate+ given its availability in our app store (other apps are only available in other countries). Moreover, the use of the camera over which participants place their index fingers often produces greater accuracy relative to apps that do not use the smartphone camera (Coppetti et al., 2017).

All students then answered some questions about this application in order to provide a plausible cover story; students indicated how much they enjoyed using the app (1 = "not at all" to 9 = "very enjoyable") and how likely they were to recommend the app to friends or a family member (1 = "very unlikely" to 9 = "very likely"). As these questions were not the focus of our study, we will not refer to them further.

During debriefing, no participants indicated any suspicion about the study.

4.3. Results

Participants who read and wrote about the health benefits of coffee scored lower on the BIF ($M = 6.21$, $S.D. = 3.12$; $n = 180$) than those who read and wrote about the benefits of tea ($M = 6.99$, $S.D. = 2.62$; $n = 181$), $t(3\,5\,9) = 2.46$, $p = .01$, $d = 0.27$ (95% C.I.: 0.05, 0.48).

We then examined the heart rate pulses as captured by the smartphone app for each participant. The kurtosis (-0.01) indicated minimal skewness; our data were largely normally-distributed and so we did not log transform the results (Sheskin, 2011). Those who read and wrote about the benefits of coffee had higher heart pulses per minute ($M = 76.05$, $S.D. = 14.38$) than those who read and wrote about the health benefits of tea ($M = 70.04$, $S.D. = 14.64$), $t(359) = 3.49$, $p < .001$, $d = 0.38$ (95% C.I.: 0.16, 0.59).

We conducted a mediation analysis to test whether heart rates would account for the impact of coffee cues on concrete construal. We again used Model 4 by Preacher and Hayes (2008); beverage was the independent variable, BIF was the dependent variable, and heart rates were the mediating variable. The indirect effect of coffee cues on construal through heart rates was estimated to lie between -0.10 and -0.01 (5,000 samples, 95% C.I.); the absence of zero in this interval indicates that mediation was statistically reliable. Beverage predicted BIF ($\beta = 0.44$, $S.E. = 0.16$, $t = 2.75$, $p < .001$), and it also separately predicted heart rates ($\beta = 0.62$, $S.E. = 0.22$, $t = 2.81$, $p < .001$). Heart rates also predicted BIF scores ($\beta = 0.48$, $S.E. = 0.18$, $t = 2.66$, $p < .001$). But when both beverage and heart rates were included in the model to predict BIF, the effect of beverage attenuated ($\beta = 0.29$, $p = .18$, $t = 1.61$, $p = .11$), while the impact of self-reported arousal remained significant ($\beta = 0.34$, $S.E. = 0.15$, $t = 2.26$, $p < .001$).

4.4. Discussion

Replicating the results of Experiment 2, exposure to coffee cues again led to concrete construal. Crucially, we once again confirm that arousal, measured by heart rates, may mediate the effect, complementing the self-report results from Experiment 2. The use of heart rates as an arousal index overcomes limitations that are possible with self-report measures (e.g., if demand characteristics evoked arousal following exposure to a coffee cue), despite some arguments that self-reports may be better (Fowles, 1980). In any case, we provide converging effects using two different ways of capturing arousal. Moreover, our use of a smartphone app to measure heart rate offers researchers an innovative methodology to assess arousal in future research since apps can be reliably used by researchers but skin conductance tests or other physiological measures can be less feasible or more complex.

That said, because this design did not measure heart rates at the beginning of the experiment, we cannot adjust for baseline heart rate in our analyses. Though we randomly assigned participants to either the tea or coffee condition, meaning that initial heart rates should be approximately equivalent across the two, we have no data verifying this, so possible differences in the baseline heart rate

should be taken into consideration in interpreting the results. We also note that perhaps this noise in measurement, plus the strength of the lay association between coffee and arousal, as well as other unidentified individual-level factors may have contributed to the smaller effect size observed in this experiment relative to the first two.

5. Experiment 4: moderation of arousal

We have found that arousal mediates the effect of coffee-related cues on concrete levels of construal. We designed Experiment 4 to provide complimentary evidence for this relationship. Here, we manipulate arousal in a manner orthogonal to manipulation of coffee cues. This should moderate the link between coffee cues and lower level construal, according to the moderation of process strategy for testing mediation (Spencer, Zanna, & Fong, 2005). If arousal can account for the impact of coffee cues on construal, then explicitly boosting arousal should only amplify the effect by reinforcing the arousal from exposure to coffee cues; diminishing arousal should weaken the effect by weakening the arousal that coffee cues elicit. We thus manipulated arousal to determine if doing so can moderate the coffee-construal link as another way of testing arousal as a potential mechanism underlying our posited effect.

5.1. Participants

We recruited participants from Mechanical Turk (N = 342). The mean age was 36.88 years old (*S.D.* = 13.51 years old). There were 201 men and 141 women. In Experiment 3, the effect sizes were lower (relative to Experiments 1–2). Thus, we were conservative this time and estimated a lower effect size of d = 0.35 at the alpha = 0.05 and power = 0.80 levels, with df = 3 and 4 groups. According to calculations on G*Power, the required sample size was 340. Similar to Experiment 1, two participants did not enter the correct password; therefore, the online software recruited two more, for a total of 342.

5.2. Method

Participants completed the study on their personal computers.

Via random assignment, participants received the same coffee or tea manipulation as in Experiments 2 and 3. Thereafter, they completed the same measure of construal level as in Experiments 2 and 3 (the abridged version of the BIF).

Crucially, after the beverage manipulation but *before* completing the BIF, participants were randomly assigned to either a high or low arousal condition. In the high arousal condition, participants watched a five-minute video clip on YouTube taken from the movie "The Fast and the Furious" featuring a high-speed car chase. In the low arousal condition, participants watched a five-minute video clip on YouTube taken from the British movie "House of Rock." Video clips can successfully induce arousal without impacting affective mood (Mehrabian & Russell, 1974).

To ensure that the two clips only differed in arousal, we conducted a pre-test with 45 participants in an earlier MTurk study by showing them either the high arousal video or the low arousal video and then asking them to indicate how they felt on 9-point scales measuring both arousal (e.g., aroused, excited, elated; α = 0.86; from 1 = "not at all" to 9 = "very much") and affective mood (e.g., pleased, upset, proud, strong; α = 0.92; from 1 = "not at all" to 9 = "very much;" Watson et al., 1988). The clip from "The Fast and the Furious" was more arousing (M = 5.64, *S.D.* = 1.34; n = 20) than the "House of Rock" clip (M = 4.20, *S.D.* = 1.98; n = 25), t(43) = 2.84, p = .01, d = 0.86 (95% C.I.: 0.24, 1.49). The two clips did not differ in terms of affective mood (p = .95). Further, the clip from "The Fast and the Furious" was significantly above the midpoint of the scale (5 on the 9-point scale), t(21) = 2.24, p = .04, d = 0.97 (95% C.I.: 0.07, 1.88). The "House of Rock" clip was significantly below it, t(22) = 1.94, p = .04, d = 0.82 (95% C.I.: −0.04, 1.69). Therefore, the video clips did not differ on mood, only on arousal.

During debriefing, no participants indicated any suspicion about the study.

5.3. Results

A factorial between-group 2 (arousal: high, low) × 2 (beverage: coffee, tea) ANOVA revealed significant main effects of arousal and beverage cue on the BIF. Those in the high arousal group scored lower on the BIF (M = 6.64, *S.D.* = 2.67; n = 165) than those in the low arousal condition (M = 7.20, *S.D.* = 3.01; n = 177), F(1, 338) = 5.08, p = .02, d = 0.24 (95% C.I.: 0.03, 0.45). Further, those who read and wrote about the health benefits of coffee also scored lower on the BIF (M = 6.44, *S.D.* = 3.04; n = 168) than those who read and wrote about the health benefits of drinking tea (M = 7.38, *S.D.* = 2.60; n = 174), F(1, 338) = 11.56, p < .001, d = 0.36 (95% C.I.: 0.15, 0.58). The two-way interaction was significant, F(1, 338) = 5.08, p = .02, η^2 = 0.02. In the high arousal condition, reading and writing about the benefits of drinking coffee resulted in lower BIF scores (M = 5.67, *S.D.* = 2.90; n = 80) than reading and writing about tea (M = 7.39, *S.D.* = 2.22; n = 85), F(1, 163) = 18.61, p < .001, d = 0.67 (95% C.I.: 0.36, 0.99). But in the low arousal condition, there was no difference in the BIF scores among those who read and wrote about drinking coffee (M = 7.03, *S.D.* = 3.03; 88) and those who read and wrote about tea (M = 7.38, *S.D.* = 2.99; n = 89), F(1, 175) = 0.59, p = .44, d = 0.11 (95% C.I.: −0.18, 0.41). Fig. 2 presents the results.

5.4. Discussion

These findings further suggest that arousal can explain the link between coffee cues and concrete mental construal. In Experiments 2 and 3, self-reported arousal and higher heart rates mediated the effect. The current findings compliment this account,

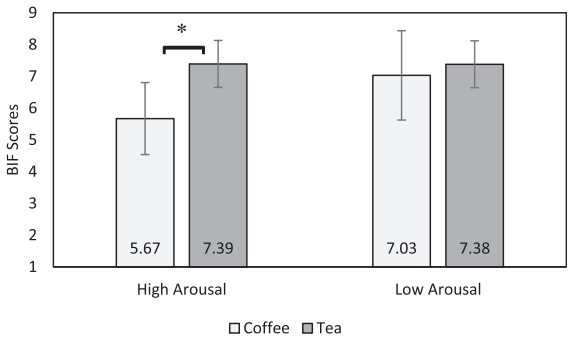

Fig. 2. Experiment 4: Interactive effect of arousal and beverage cue on BIF Scores. On the BIF, lower scores indicate more concrete thinking. Standard error bars presented. $^{*}p < .05$.

as orthogonally manipulating arousal also modulated the link (Spencer et al., 2005). When arousal remained high, the impact of coffee (vs. tea) cues on the BIF remained intact. But, when arousal was dampened, the impact of coffee (vs. tea) cues on construal level diminished.

One might wonder why our basic effect (whereby coffee cues generally lower construal relative to tea cues) did not arise in the non-arousing condition in which participants watched the clip from "House of Rock." One might reason that we should have found the basic effect as in our other experiments in which there was no arousal manipulation. Though we did not anticipate this lack of difference, the results are not necessarily inconsistent with our thesis. According to our pre-test, this video clip scored lower on arousal relative to the scale mean of 5 (on a 9-point scale), suggesting that it could have even *lowered* arousal levels—thereby attenuating any effect of exposure to coffee cues on participants' level of mental construal. Such a finding is consistent with Tuan Pham, Hung, and Gorn (2011), who reported that *attenuating* the mediating variable can reconfigure the effect of an independent variable on a dependent variable. More important was that manipulating arousal levels moderated this impact, suggesting that arousal likely explains at least some of the effect. Still, we echo a comment from Experiment 3, that while our basic effect again emerged on this modified design, the size of the effect was small in comparison to Experiments 1 and 2, implying a reliable but variable relationship.

6. General discussion

Across four studies, we document an association between coffee and arousal and a series of effects deriving therefrom. As higher levels of arousal reduce psychological distance, coffee cues—even without actual consumption of the beverage—can reduce the level of mental construal at which people appraise different targets of consideration. In Experiment 1, coffee cues decreased temporal psychological distance, but only for individuals from Western backgrounds, consistent with our lay-association-related process model. In Experiments 2 and 3, arousal mediated the effect of coffee cues on a lower level of construal, with arousal measured via self-reports and heart rates. We then manipulated arousal in Experiment 4 and found that it moderated the effects. Taken together, the findings converge on the idea that coffee and tea (which are two prominent beverages in Western cultures) can stimulate arousal via related cues and alter patterns of thought.

We document the novel effect whereby exposure to coffee-related stimuli sans actual ingestion can increase arousal. Prior work on coffee and tea has focused on actual ingestion of these beverages. We interface with the literatures on cognitive associations and priming to suggest that arousal might be possible without actual ingestion of caffeine from drinking coffee. Consistent with the prediction derived at this intersection, it is possible to raise arousal simply via exposure to coffee cues, and thus we add to work that documents lay associations regarding food or beverages, this time by focusing on two of the most popular global beverages. We also broaden the scope with which to conceptualize the understanding of food and beverage as activating related concepts. The fact that coffee and tea are two of the world's most popular beverages, indeed, necessitates a greater understanding of their effects beyond the dominant focus to date on physiology. Given that there are many associations held about these and other beverages, such associations can likely have effects on cognition. We advance the collective understanding in this area by testing, confirming, and building from Western individuals' lay beliefs that coffee is an arousing beverage.

Moreover, our investigation is the first to conceptually and empirically link higher arousal with lower mental construal. While various physiological and cognitive effects of high arousal are consistent with this premise (Gorn et al., 2001), it has not been tested before. Arousal narrows focus and directs attention to matters at hand, which we leverage to suggest that it should also bring a focus into the here-and-now, reducing psychological distance to targets under consideration (Experiment 1). Because psychological distance affects level of construal (Trope & Liberman, 2000, 2010), arousal triggers a concrete level of construal. We show the construal-linked effects of arousal on a measure of abstraction in Experiments 2, 3, and 4. Note that, rather than strictly coffee cues, *any* cue that heightens arousal—whether through physiological or psychological means—should also elicit more concrete thinking. This does nothing less than bring a fundamental facet of physiology—as well as one of the two dimensions of affect (i.e., arousal; Feldman, 1995)—to bear on one of the most impactful and prevalent frameworks through which to understand and predict behaviors put forth in the last twenty years (i.e., CLT).

People not only drink coffee and tea everyday—they are also continually exposed to all manner of cues related to coffee and tea that, according to our findings, should change their level of arousal and construal. Coffee shops abound, some at every corner of an intersection, and our results suggest that people may be more aroused simply after walking by a coffee shop. Not only would they be more aroused but, at a more downstream level, their decision making might shift as well. For example, Trope and Liberman (2000) found that level of construal reliably shifts the priorities people place on different types of product attributes, and our account would imply that exposure to coffee or tea cues (or any means by which to manipulate arousal) should act as an input into shifting such decision attribute weighting. This is one of various relationships by which changes in construal affects a host of decisions; we add to this by noting the importance of understanding how these common beverages might affect such decisions.

Thus, our research can offer intriguing implications, as it relies not on physiology but instead on psychological associations to change patterns of cognition. Indeed, our findings might help to explain both Knowles (1963) and Fukuda and Aoyama (2017) findings that drinking even knowingly *de*caffeinated coffee can produce faster reaction times on tasks. Perhaps the mental association between "coffee" and "arousal" is so strong that it can produce cognitive changes even when there is no caffeine ingestion physiologically. In other words, our findings suggest that the arousal from drinking coffee (and potentially other caffeinated beverages) might arise not purely from physiological processes but also from psychological processes.

There are, though, other considerations to consider. We found that our effect primarily arises for people from Western backgrounds. Strictly within coffee-drinking Western societies, there are still many other kinds of coffee: espressos, cappuccinos, and lattes, which differ in their caffeine levels—and, thereby, potentially in their evoked arousal levels. Since individuals likely associate espresso as even more arousing than, say, a latte, reminders of espressos may increase arousal more than lattes. Black tea tends to be stronger than green tea, thus exposure to black tea concepts may lead people to experience greater arousal and a more concrete construal level than green tea. We acknowledge that these predictions depend upon the extent to which people discriminate between particular types of coffee and tea (varying in caffeine-related strength, vs. generalizing all coffees or teas as being essentially the same), and we also acknowledge that the investigation here only focuses on and defines both coffee and tea in relatively broad terms. We did not direct participants to focus on any particular coffee type or tea type, and so it might be possible that our effects on both arousal and construal can weaken or strengthen for different beverage types. It is likely that our effects would be stronger for espresso than for decaffeinated coffee, as just one of many possible moderations of and boundaries to our findings.

There is also the possibility of additional cultural differences. We do not simply mean differences *between* cultures but also *within* cultures. Between cultures, there are societies where tea, as a beverage, may be more dominant and more commonly consumed. Thus, it might be the case for tea drinkers that arousal may be elicited for them from tea cues instead. Stanley and Schlosberg (1953) found some evidence for this among habitual tea-drinkers, for whom the effects of tea on simple and complex reaction times were demonstrably faster after its ingestion than among non-tea drinkers, despite the fact that the caffeine amount was identical. They did not focus on arousal (nor on construal), and thus it is less clear what drives the mechanism; a classical conditioning account may be possible. As food and beverages can have various meanings in various cultures, more work remains to better understand such culturally-dependent associations and their effects on cognition.

Even within a culture, there are various associations for given foods and beverages. In Western cultures, there may be other associations about coffee or tea on which we do not focus. In Europe and North America, some teas are hallucinogenic, as in the case of angel's trumpet tea (Göpel, Laufer, & Marcus, 2002). For individuals who habitually drink such teas, exposure to relevant tea cues might lead to a hallucinogenic reaction because such reactions can be elicited by "mind-pops" (involuntary semantic memories; Elua, Laws, & Kvavilashvili, 2012). Some Westerners might also prefer tea over coffee, making them exposed to a wide variety of tea types and aware of the substantial variation in tea's caffeine levels. As such, reminders of certain types of tea rather than coffee could prove more arousing. Accordingly, it might be *tea* cues that reduce construal levels for these individuals because priming effects arise from psychological or mental associations.

Future research might measure arousal differently because it is a holistic construct comprised of many facets. We have relied on self-reported arousal and physiological indicators (Experiments 2–3), but other measures exist, such as visual or perceptual attention (Gorn et al., 2001) and even bio-neural markers. In particular, Ferré (2010) argued that caffeine's effects are moderated by the central ascending neurotransmitter systems involved in motor activation as well as reward (dopaminergic systems) *and arousal* (cholinergic, noradrenergic, histaminergic, orexinergic systems). The ascending reticular activating system, in particular, can exert a potent modulating impact on executive functions including attention paid to irrelevant stimuli (Woods & Knight, 1986) and memory processes (Ramos & Arnsten, 2007) that might also shed light on construal, as construal processes affect the processing of non-task specific stimuli and memory (Kyung, Menon, & Trope, 2010). Thus, future extensions of our work might wish to investigate if coffee cues can trigger these systems or even neurological changes in the brain. We only focus on two arousal measures and only from a lens of social psychology. There are others that adopt a cognitive neuroscientific approach that might complement our research. This can even serve to explore other potential moderators of our effect since some people are higher or lower on arousal levels in that their baseline arousal and need for stimulation differ (Strelau & Eysenck, 1987). A related possibility might be that, if coffee cues abound in Western cultures, then arousal levels for those living in these areas of the world would be high on baseline arousal. This would generate macro-level evidence for our hypotheses, but, here, care must be taken because causality may be hard to distinguish using secondary analyses.

The potential for moderating effects does not lie solely in cross-cultural comparison. Some individuals are naturally more tolerant of higher arousal and may even prefer it. We are, though, agnostic as to whether this individual difference would strengthen or weaken the effects. On the one hand, arousal via coffee cues might be stronger among these people, as they may be more sensitive to arousing stimuli. On the other hand, they might require "stronger" stimulation that can only be derived from more overt and powerful manipulations of arousal (e.g., actually drinking coffee). It would be interesting for further work, for which our work offers

a conceptual framework, to explore such potential intra- and inter-cultural variations. Our work is necessarily broad as we are the first to study the impact of coffee and tea cues on arousal and construal, but other differences in the forms of and/or meanings associated with coffee and tea (and other foods and beverages) warrant further work.

Moreover, it is reasonable that the arousal that is evoked by mere coffee cues may be weaker than physiologically-induced arousal from drinking coffee. This continuum of experienced arousal dovetails with the possibility that arousal might be optimal at a certain task-dependent level (Yerkes & Dodson, 1908). Extreme levels of arousal might simply overwhelm executive functioning skills and information processing ability, similar to how cognitive load can harm performance. Here, we stress two points. Our research is on construal level, and not on executive functioning. But, given that how people think (e.g., construal level) is derived from higher-order processes (e.g., executive functioning), our results might suggest that coffee cues would affect executive functions, specifically by shaping how people mentally represent and construe stimuli. Second, we take no position as to the superiority of one level of construal over the other, nor of high versus low arousal. Even at moderate arousal levels, performance on different tasks might be optimized by different levels of construal (Schmeichel, Vohs, & Duke, 2011). These are but a few questions to be considered when applying and extending our research. We offer a starting point for future work to examine the positive *and* negative consequences of exposure to cues related to coffee and tea.

Finally, we acknowledge that further replication of our results, especially with larger sample sizes, are necessary, though we are also mindful of the fact that large sample sizes can result in Type 1 errors (Lin, Lucas, & Shmueli, 2013). Our sample sizes were relatively small, but they were determined by *a priori* calculations based on the sequential nature of our experiments. In any case, we await further work to replicate our basic effects, providing practitioners and researchers further credence in the validity and reliability of the findings.

In sum, our research adds to the literature documenting that the foods we eat and the beverages we drink do more than simply providing nutrition or pleasure. Mere exposure to or reminders of them can affect how we think. Our societies have imbued certain ingestibles with psychological meaning such that, upon considering them, thoughts and behaviors follow suit. Coffee cues increase arousal—at least for individuals living in Western societies—and shift the mental level at which they process information. As such, our work is situated amongst a broader stream that connects food and beverage concepts to decision-making. Our finding that arousal influences cognition in this manner is of substantial theoretical and practical importance because other determinants of arousal may similarly affect distance and thus construal levels. We focus on coffee, but a greater exploration of the multi-faceted nature of other foods and beverages and their impact on how people think and process information is needed given their prevalence.

Appendix A

Behavioral identification form

Any behavior can be identified in many ways. For example, one person might describe a behavior as “typing a paper,” while another might describe the behavior as “pushing keys.” Yet another person might describe the behavior as “expressing thoughts.” We are interested in your personal preferences for how a number of different behaviors should be described. On the following pages you will find several different behaviors listed. After each behavior will be two choices of different ways in which the behavior might be identified. Here is an example:

Attending class

a. Sitting in a chair
b. Looking at the blackboard

Your task is to choose the identification, *a* or *b*, that best describes the behavior for you. Simply place a check mark in the space beside the identification statement that you pick. Please mark only one alternative for each pair. Of course, there are no right or wrong answers. People simply differ in their preferences for the different behavior descriptions, and we are interested in your personal preferences. Be sure to mark your choice for each behavior. Remember, choose the description that you personally believe is more appropriate for each pair.

1. Making a list
   - o Getting organized*
   - o Writing things down
2. Picking an apple
   - o Getting something to eat*
   - o Pulling an apple off a branch
3. Chopping down a tree
   - o Wielding an axe
   - o Getting firewood*
4. Measuring a room for carpeting
   - o Getting ready to remodel*
   - o Using a yard stick
5. Locking a door

- o Putting a key in the lock
- o Securing the house*

6. Voting
   - o Influencing the election*
   - o Marking a ballot
7. Taking a test
   - o Answering questions
   - o Showing one's knowledge*
8. Growing a garden
   - o Planting seeds
   - o Getting fresh vegetables*
9. Traveling by car
   - o Following a map
   - o Seeing countryside*
10. Pushing a doorbell
    - o Moving a finger
    - o Seeing if someone's home*

*Abstract alternative

Appendix B. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.concog.2019.02.007.

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