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Some Aspects of the Liking for Hot Coffee and Coffee Flavor

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Interviews with 180 American adult coffee-drinkers indicated that the liking for coffee flavor is often limited to just hot coffee beverage. Liking for coffee flavor in other forms (yogurt, liqueur, iced coffee) was only very weakly related to liking for hot coffee, indicating an important role for context in liking for coffee. Measures of the morning effects of coffee and addiction to caffeine correlated relatively well with the liking for hot coffee beverage, but only weakly with liking for coffee flavor in other contexts. There was some correlational evidence that pharmacological effects of caffeine, especially its calming action, are involved in the development of a liking for hot coffee beverage.

This study addresses two basic issues in the acquisition of affect. Both are considered with respect to the acquisition of likings for food and in particular, coffee. The first issue is the role of particular positive consequences of ingestion of a food in affective change in response to that food. The second issue concerns the problem of context and generalization in the acquisition of affective responses.

The use of coffee as a vehicle to explore these issues seems quite appropriate. It is consumed by a higher percentage of adults in the United States than any other beverage, except water (Pan American Coffee Bureau, 1976), and is one of the most widely consumed pharmacologically active substances in the world (Levenson & Bick, 1977). The psychopharmacological effects of caffeine, the best known pharmacologically active constituent of coffee, have been extensively studied (Gilbert, 1976). Coffee ingestion is rarely negatively sanctioned in adults, so that it is quite easy to obtain information on use and attitudes from coffee drinkers. Conveniently, for the purposes of research, coffee is commonly used in both the natural, pharmacologically active form, and in decaffeinated form.

The widespread popularity of coffee is surprising, since it has a bitter taste which causes it to be unpalatable to the great majority of people on first contact. In this respect, coffee resembles tobacco, alcohol, quinine water and the irritant spices such as chili pepper: all are popular ingestants for humans and all are innately unpalatable, because they stimulate the innately programmed bitter or irritant rejection systems (Garcia & Hankins, 1975; Rozin, 1976). For most humans, experience with coffee leads to an *affective* shift, with dislike turning into like. It is this transition and its causes that are the concern of this paper.

At this time, we know very little about the types of events that can produce an affective shift (Rozin, 1979; Rozin & Fallon, 1981). Exposure to an item or event over a

This research was supported by a grant from the National Science Foundation (BNS-76-80108). We thank Patricia Pliner and Ingrid Waldron for helpful comments on the manuscript, and Janet Theophano and Joanne Weller for arranging access to the Black and Italian subjects in the South Philadelphia community.

number of occasions may be a necessary condition for this to occur; Zajonc (1968) suggests that it is a sufficient condition. Consideration of cases where affective changes (usually in terms of liking or disliking of "tastes") do or do not occur adds to the puzzlement of this phenomenon: thus, innately unpalatable chili peppers come to be liked after many exposures (Rozin & Schiller, 1980), whereas gelusil, which tastes rather pleasant and produces clear positive effects, rarely comes to be liked. On the other side, ingested foods that produce allergic responses of the skin or respiratory system are avoided but not disliked, whereas foods that produce marked nausea on one occasion are subsequently disliked (Garb & Stunkard, 1974; Pelchat & Rozin, Note 1; Rozin & Fallon, 1980).

Systematic study of the acquisition of a liking for another innately unpalatable substance, chili pepper, has uncovered a number of possible mechanisms, but none has yet been firmly established (Rozin, 1978; Rozin & Schiller, 1980). These mechanisms all involve the mediation of culture, at least in the sense that cultural (social) forces sustain ingestion for a period, while the substance is disliked, and allow the processes that produce liking time to operate (Rozin, in press). Inherently culture-related factors may also be involved in the development of liking *per se*. This is suggested by the fact that it is very difficult to establish likings for innately unpalatable substances in laboratory rats (Rozin, Gruss, & Berks, 1979; Zahorik, 1979) as well as indications of special potency for social factors in preference acquisition in children (Birch, Zimmerman, & Hind, 1980).

It must be noted that liking is not always indexed by preference (Rozin, 1979). It is possible and common, to prefer A to B and like B better than A. A dieter, in choosing cottage cheese over ice cream, would demonstrate this dissociation. We cannot assume that preferred foods are liked; many foods are eaten by humans because they are available and inexpensive. However, it is clear that many people like the taste of coffee (Goldstein & Kaizer, 1969), and there is no doubt that the preference for chili pepper is based on a liking for the very burn that is originally disliked (Rozin & Schiller, 1980). The distinction between liking and preference is harder to establish with animals. There is a report of an acquired *preference* for low concentrations of caffeine in caffeine-addicted rats (Vitiello & Woods, 1975). The solution involved in this study was not very bitter (caffeine is *not* the primary source of bitterness in coffee), but the preference was quite clear. The question is whether the animals learned to consume the caffeine in order to relieve withdrawal symptoms, or actually developed a liking for the taste.

There are no studies that directly examine the nature and origin of the liking for coffee. In an excellent study of the determinants of coffee use, Goldstein and Kaizer (1969) administered questionnaires on coffee drinking habits to housewives in California. Their results indicate that most coffee users like the taste of coffee, and there is some tendency for those who drink more cups to report liking the taste as a reason for drinking with higher frequency. This study along with some of our own work (Rozin & Cines, Note 2) indicates that coffee can be consumed for a variety of reasons; liking the taste is a very common, but not necessary reason.

A second issue addressed in this paper concerns the prevalence of context sensitivity in affective responses. For example, a sour-spoiled odor is considered pleasant when emanating from cheese; yet this same odor, if attributed to raw milk, is offensive. The case of coffee seems to be an appropriate instance for investigation of these effects since coffee is available as a flavoring in a variety of forms. Although coffee beverage is extremely popular, and the aroma of coffee is found to be pleasant by almost everyone, coffee is rather rarely used in contexts outside of the hot beverage. Furthermore, when

available, coffee-flavored products are not popular. We will explore the relations among liking for coffee flavor in the hot beverage and in other forms, sensitivity to variations in the flavor, and the relation of all of these sensory hedonic variables to the specific physiological and psychological effects that coffee (caffeine) produces in particular individuals.

METHOD

Subjects

Our major concern was to obtain information from people with a wide variety of coffee drinking habits. As a result, we sought a sample that was heterogeneous with respect to age and ethnic origins. However, we made no special efforts to balance the population, since estimating normative frequencies was not a primary aim. We interviewed 180 subjects (137 female).

In order to qualify for the interview, subjects had to drink coffee at least once a month. All but 12 subjects were regular drinkers, in the sense that they consumed at least one cup per day on a regular basis. Subjects were obtained through a variety of means, including friendship (and friends of friends), advertisement and, for about half of the subjects, interviews arranged by a staff member of a community center in South Philadelphia. Subjects were either from a lower class neighbourhood associated with this community centre, or directly or indirectly associated with the University of Pennsylvania. The sample of 180 included 48 Blacks, 52 Italians, 41 Jews, 25 "White North Central European Christians" and 14 subjects of uncertain ethnic group. The average age of the sample was 35.7 years (standard deviation of 14.9), with a range of 15–82 years. Subjects drank 3.8 (mean) cups of coffee per day (3.3 cups caffeinated coffee/day). Decaffeinated coffee accounted for 13.4% of the cups. These values are quite comparable to data from a survey of coffee drinking based on systematic sampling of Americans (Pan American Coffee Bureau, 1976).

Procedure

All of the data come from the results of one-hour interviews. A structured protocol was used; ambiguous or otherwise puzzling responses were probed to clarify them. Specific items will be discussed as they become relevant. A wide variety of hedonic ratings were obtained, all of which were based on a standard nine-point scale (1 = dislike extremely; 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly; 5 = neither dislike nor like; 6 = like slightly; 7 = like moderately; 8 = like very much; 9 = like extremely).

Most of the data analysis is correlational. With the sample size of 180, a Pearson product-moment correlation of 0.15 is significant at less than 0.05 (two-tailed). However, we will ordinarily discuss, as worthy of comment, only correlations of 0.20 or more ($p < 0.01$, two-tailed).

Our general strategy in data analysis was to develop a series of measures of the sensory-hedonic aspects of hot coffee beverage and other forms of coffee flavoring, and measures of the physiological and psychological effects of drinking coffee. We relied primarily on common sense in constructing the composite scores. We then compared the various sensory hedonic measures to examine context issues and compared hedonic with effects measures to explore possible determinants of liking. The following Results section incorporates some specific procedures so that the questions and analyses can be

presented along with the results. We first present descriptions of each composite measure, with comments about issues raised by the data contributing to each score. After describing each composite score, we examine the issue of context and generalization and then hedonics-effects relations.

RESULTS

Hot Coffee Liking

Subjects indicated the form in which they normally drank coffee (black, cream, sugar, cream and sugar), and rated it on the nine-point hedonic scale. We also asked them to rank coffee (in the form they usually drank it) with 12 other common beverages (cold milk, fresh orange juice, favorite other fruit juice or drink, cola soda, favorite non-cola soda, hot chocolate, water, tea, beer, wine, hard liquor, iced coffee) in terms of favorite (1) to least favorite (13).

The overwhelming fact about coffee drinkers seems to be their love for the flavor of coffee. Almost all (87.7%) subjects rate their liking for the taste of coffee, as they drink it, as "like extremely" or "like very much" (8 or 9) (Mean: 8.35). Of course, we are dealing only with coffee drinkers. Nonetheless, most regularly consumed foods and drinks would not achieve anything like these high ratings on the nine-point scale. Only one subject disliked the taste of coffee (as drunk) and two were neutral. Hot coffee ranked 3.5 (mean) among the 13 common beverages: the modal position was *first* (32.6%).

The limited range of the hedonic measure (mean 8.35 with 9 maximum) compromises its usefulness as a basic measure of liking. We combined it with the ranking so as not to abandon the direct hedonic measure but, at the same time, to take advantage of the greater differentiation (variation) of the ranks measure [the correlation of hedonic and rank measures is -0.45 (Pearson r)]. We computed a composite score, Hot Coffee Liking, by adding the hedonic rating to the inverted ranking (14 minus the actual ranking) (both components are based on coffee as drunk). Using this formula, a person with a maximum "liking" would score 22 (9 hedonic + 1 rank) (see Table 1 for summary). This hot coffee liking score will be used as the basic measure of liking for hot coffee in the remainder of this analysis.

TABLE 1
Summary of basic measures

Measure	Maximum possible range	Actual range	Mean	Standard deviation
Hot coffee liking	2-22	5-22	18.87	3.44
Iced coffee liking	2-22	2-22	8.83	5.80
Flavor enhancement	3.0-9.0	3.0-8.7	5.20	1.39
Morning effects	0-81	21-81	45.69	15.16
Addiction	0-19	0-16	4.27	4.09

Iced Coffee Liking

There was considerable variability on the hedonic rating for iced coffee. However, since we also had rankings of iced coffee, we elected to combine rank and hedonic

rating, as with the hot coffee liking score (Table 1). The hedonic response to iced coffee (as drunk) is much lower, with a mean rating of 4.53 (below the neutral point) and a mean rank of 9.79.

Flavor Enhancement

We computed a flavor enhancement score, which indicates the extent to which a person likes the flavor of coffee outside of the hot beverage context. We asked each subject to rate, on the nine-point hedonic scale, six possible foods or beverages (yogurt, ice cream, candy, milk, cake and liqueur) that might serve as vehicles for coffee flavor. Subjects rated these foods three times: first with coffee flavor, then plain (without any flavor added) and finally with their favorite flavor added. The flavor enhancement score derived from these responses factors out the baseline preference for the vehicle.

For each context, we gave a subject a score of 3 if coffee flavor made the vehicle (plain form) taste worse, 5 if the vehicle was equally palatable with or without coffee flavor, 7 if coffee flavor enhanced the palatability of the vehicle and 9 if coffee flavor was the favorite flavor, or equal to the favorite flavor. We averaged the scores for all vehicles, for each subject, to yield a composite score on the same 3–9 scale as the individual ratings. (Analysis of the intercorrelation matrix for the 6 scores across subjects shows that they are positively related: correlations are in the +0.2 to +0.5 range.) A subject who loved coffee flavor would score 9 for each vehicle and end up with a composite (mean) score of 9. A subject who thought that coffee flavor would make each of the vehicles taste worse would have a composite score of 3. Scores greater than 5 indicate net enhancement, while those less than 5 suggest negative flavor effects (Table 1).

The nature of the vehicle influences the palatability of coffee flavor. Coffee enhanced the palatability of liqueur (mean 6.14), candy (5.83) and ice cream (5.78), and detracted from the palatability of milk (4.11) and cake (4.17). There was very little net effect with yogurt (4.83).

Morning Effects

Unlike the previous measures, this score represents the effects of coffee, rather than sensory-hedonic properties. Goldstein and Kaizer (1969) have described the psychological and physiological effects that people attribute to their morning cup of coffee. We also examined the effects reported from the first cup of coffee, using a modified version of their checklist. The items emphasize effects that could be attributed to the action of caffeine.

We asked subjects whether they experienced any of nine effects, with respect to their first cup of coffee of the day. The nine states queried were: alert–energetic, relaxed–content–calm, anxious, restless–nervous–jittery, sleepy, tired–sluggish, headachy, irritable, disoriented–inefficient. For each state, the subject was asked to indicate: (1) whether she experienced this state before drinking the first cup of coffee; (2) whether omission of this cup would cause an increase, decrease or no change in this state; and (3) whether there would be any change (increase, decrease, no change) in this state after drinking the cup of coffee.

Our scoring system gave more points the more positive the direction of change (e.g., *more* alert, *less* irritable) following coffee, and the more negative the change if coffee was omitted. Table 2 describes the method for assigning points to each of the states.

A score of 5–9 on any of the nine mood states indicates that a cup of coffee produces positive effects: the subject felt better after a cup and/or felt worse without it. The higher

TABLE 2
Scoring method for the effects from the first cup of coffee

State (mood) before cup	State (mood) if cup omitted	State (mood) after cup	Score
Bad ^a	Worse	Better	9
Bad	Same	Better	8
O.K. ^a	Worse	Better	7
O.K.	Same	Better	5
Bad	Better	Better	4 ^b
O.K.	Same	Same	3
Bad	Same	Same	3
O.K.	Same	Worse	1
O.K.	Better	O.K.	1

^a“Bad” means a “yes” response to the seven negative states (moods) or a “no” response to the two positive states. O.K. refers to the opposite responses, for each type of case.

^bIn this instance, the subject reports feeling “better” with or without drinking a cup of coffee. The scoring of 4 is put above neutral (3), because there would be a fortuitous association between coffee drinking and feeling better.

the number, the clearer the effect. A score of 1 indicates net negative effects; and a score of 3 indicates no net change mood state.

The morning effects score is the summation of the coded scores for each of the nine mood-states. Each of the nine component states is positively related to every other one. As might be expected, the strongest correlation is between “sleepy” and “tired-sluggish” ($r=0.649$), and the weakest between “anxious” and “sleepy” ($r=0.149$). Some effects are very frequent and others are relatively rare. Clear effects scores (7–9) are most common for “alert-energetic” (63% of cases), “tired-sluggish” (53%), “sleepy” (51%), and “relaxed-contented-calm” (44%). These four categories are also most commonly mentioned, and in the same order, in the Goldstein and Kaizer (1969) study, sampling wives of Stanford University graduate students. A score of 27 (9 moods, each scoring 3) would indicate absolutely no net effects of coffee, along the dimensions we probed (Table 1). This measure takes into account both the number of the effects, and, to some extent, their intensity. However, the score would not differentiate between a person for whom coffee had definite but moderate positive effects across all moods, and one who had much stronger effects, but on a few moods.

Nine subjects recorded effects scores below 27, indicating net negative effects. One of these subjects drank decaffeinated coffee. The most common negative effects (1 scores) were increases of “restless-nervous-jittery” (7% of cases) and decreases of “relaxed-content-calm” (7% of cases).

As would be expected, subjects who drank decaffeinated coffee for their first cup (within 2 h of awakening) showed lower morning effect scores (mean of 37.4 for 14 subjects) than subjects drinking caffeinated coffee in the same period (mean of 47.5 for 138 subjects, $p < 0.01$ for a one-tailed t -test). However, we note that 37.4 is substantially above the “no effects” level of 27; 4 of 14 decaffeinated coffee drinkers reported substantial (44 or more) morning effect scores.

Addiction

There is a fair amount of evidence suggesting that caffeine is a mildly addictive substance. In particular, the phenomenon of caffeine withdrawal headache has been

reported (Dreisbach & Pfeiffer, 1943; Goldstein & Kaizer, 1969). We have computed an addiction score, composed of variables that we would expect to indicate addiction to caffeine. Subjects who drank only decaffeinated coffee were assigned an addiction score of zero. Others were asked the following questions: (1) How long after awakening does the subject drink his/her first cup of coffee? Immediately: 4 points; less than 15 min: 2 points. (2) Time of last cup of caffeinated coffee. Within 1 h of bedtime: 2 points; within 2 h of bedtime: 1 point. (3) Does missing any cup other than the first cup(s) of the morning result in negative mood states? Yes: 3 points. (4) Based on check-list data, does the subject feel the need for the morning cup of coffee? Yes: 2 points. (5) Based on check-list data, does the subject feel bad if the morning cup is omitted? Yes: 2 points. (6) Based on check-list data, does the morning cup of coffee relieve or forestall a headache? Yes: 5 points. The score takes into account indications of withdrawal and tolerance, and aspects of the drinking pattern (Table 1).

Sensory-Hedonic Aspects of Hot Coffee Beverage and Coffee Flavor

The generally known disparity between the great popularity of hot coffee beverage and limited liking for other items with coffee flavor is clearly supported by the hedonic ratings we have presented. Hot coffee beverage seems to be a different entity from all other forms (see Discussion). The flavor enhancement score shows a low correlation with hot coffee liking (Table 3). It is quite common to love hot coffee and dislike all other forms of coffee flavor. Most surprisingly, there is not a significant relation ($r=0.106$) between liking for hot and iced coffee. Rather, iced coffee liking relates to flavor enhancement ($r=0.492$). Iced coffee should be thought of as disembodied coffee flavor in a new vehicle, rather than as a minor variant of hot coffee. There does seem to be a general coherence for liking of coffee flavor in vehicles other than hot water (hot coffee) but this relates only weakly to the liking for hot coffee.

TABLE 3
Correlations among major variables (Pearson r) (N = 180)

	Hot coffee	Iced coffee	Flav. enhancement	Morn. effect	Addict
Hot coffee liking	xx				
Iced coffee liking	0.106	xx			
Flavor enhancement	0.193*	0.492**	xx		
Morning effects	0.334**	0.120	0.117	xx	
Addiction	0.269**	-0.113	0.138	0.540**	xx
Caffeinated cups/day	0.268**	0.037	0.003	0.320**	0.550**

* $p < 0.01$, two tailed t -test.

** $p < 0.001$, two tailed t -test.

Liking for Coffee and the Effects of Coffee

The morning effects and addiction responses we refer to are almost entirely associated with hot coffee beverage, since it is the predominant consumed form of coffee and, with the exception of iced coffee, the only form with substantial levels of caffeine. Under the circumstances, it is not surprising that the only significant correlations between either morning effects or addiction scores and a hedonic measure are with hot coffee liking (Table 3). A correlation with flavor enhancement might represent, if

present, some type of generalization from the association of coffee flavor in the coffee beverage with positive effects. The results (Table 3) indicate that whatever causes the liking for coffee flavor outside the hot beverage context is almost entirely unrelated to caffeine effects.

Greater morning effects do predict greater liking for hot coffee ($r=0.334$, Table 3). This basic effect is also illustrated in the relatively low coffee liking scores of nine subjects reporting net negative effects (mean hot coffee liking of 15.9, compared to the sample mean of 18.9).

This effect can be analyzed further, by examination of the contribution of specific morning effects to the relation. The results of this analysis are displayed in Table 4. Note that all relations are positive. The low scores for sleepy, tired and headachy may result in part from the low variation in effects scores for these components. Relaxed—calm and reduction of nervousness—restlessness—jitteriness seem to be most linked to liking. The correlation of hot coffee liking with the nervousness measure is about as strong as its correlation with the total morning effects score.

TABLE 4

Relation between individual morning effect scores and hot coffee hedonics (N = 180)

	Pearson r
Restless, nervous, jittery	0.345**
Relax, calm	0.309**
Disoriented, inefficient	0.249**
Anxious	0.237*
Alert, energetic	0.234*
Irritable	0.220*
Tired, sluggish	0.121
Headachy	0.113
Sleepy	0.060

* $p < 0.01$, two tailed t -test.

** $p < 0.001$, two tailed t -test.

There are data from another section of our interview that bear on this point. We asked subjects to give reasons for drinking each cup of coffee that they drank during the day. After completing this task, subjects were given a checklist of suggested reasons for drinking coffee, and indicated, for each cup, the reasons that applied. We analyzed the check-list data for the first cup of the day, by dividing the subjects into two groups, for each possible reason: those checking it, and those who did not. We computed a hot coffee liking (mean) score for each group. As expected, for any effect that we examined, the group checking the effect showed a higher liking score (usually significant at at least the 0.01 level) than the group not offering that effect as a reason for drinking (Table 5). These reasons are arranged in order of decreasing effect on the liking score in Table 5. The order of reasons is the same as the order generated by the spontaneous reasons given for any of the different cups, though there are fewer total reasons in the spontaneous data, and the differences are smaller. In both of these cases, and in the analysis presented above from morning effects (Table 4), the calm—relaxing effects of caffeine seem most related to liking, with the orienting—thinking effects next. Stimulation effects seem less potent as correlates of liking. The similarity in these analyses is interesting, because the reasons analysis cannot be explained in terms of

differences in the variability of response to the different effects. Taken together, these three data bases suggest special affective potency for certain types of effects, though the correlations themselves do not permit a causal attribution. Included in Table 5, and in the spontaneous response data, is an item that can loosely be called general positive effects, "a feeling of well-being". This may not be a caffeine effect. It showed the highest difference for both the check-list (Table 5) and spontaneous reasons.

TABLE 5
Liking for hot coffee and specific effects of morning coffee (N = 180)

Check list category	Difference in hot coffee liking score between subjects checking relevance of this category, and subjects not checking it	Significance of difference*
It gives you a feeling of well-being	2.35	0.001
It calms your nerves, makes you relax	2.06	0.001
It helps you think, it helps orient you	2.02	0.001
It makes you less irritable	1.87	0.001
It wakes you up, gets you going	1.72	0.01
It reduces or avoids a headache	1.64	0.05
You would feel bad without it	1.52	0.01
It stimulates you, gives you energy	1.39	0.01
It fills you up**	0.07	NS

* Two-tailed *t* test.

** Assumed not a caffeine effect.

The addiction score shows a high correlation (0.54) with morning effects, as might be expected from two measures based on the action of caffeine. A state of caffeine withdrawal in the morning, for example, would contribute to both scores. The addiction score also shows a relation to hot coffee liking ($r = 0.26$), and no correlations above 0.2 with any other variables (Table 3). The best predictors of amount of caffeinated coffee drunk per day are addiction, morning effects, and liking for hot coffee (Table 3).

In light of the analysis on liking for coffee flavor, and the relation between caffeine effects and liking, it should not be surprising that liking for hot coffee beverage, morning effects, and addiction predict level of hot coffee beverage intake (number of caffeinated cups/day) while iced coffee liking or flavor enhancement do not (Table 3).

DISCUSSION

We shall discuss the two principal findings in turn. The first is that coffee flavor is strongly liked only in the context of the hot beverage, and that hot coffee liking is related only very weakly to the liking for coffee flavor in other contexts. The greater liking for hot coffee beverages may result in part from greater exposure to it. It is typically the earliest form of coffee flavor that is experienced, as well as the predominant form consumed at any age. Of course, this could be the result of a greater liking, rather

than its cause. The low correlation with other coffee flavors is highlighted by the fact that quite a few of our subjects with high hot coffee liking scores have low flavor enhancement scores: they like coffee flavor only in hot coffee beverage, or, put in another way, they like coffee only with hot water as the vehicle. And, although it does not appear in our data (since we only interviewed coffee drinkers), there are people (including one of us) who like coffee flavored vehicles and dislike all forms of hot coffee beverage. This disparity may result in some cases from dislike of the bitterness of hot coffee, coupled with a liking for the aroma and other flavor components.

Nonetheless, the low correlation between hot coffee liking and flavor enhancement is surprising: generalization should lead to stronger relations, especially with respect to iced coffee. And yet iced coffee liking is much more closely related to liking for coffee flavor in vehicles other than water. There is a notable additional separation of coffee flavor from hot coffee beverage in an analysis of the data base for this study by ethnic group. Jews, as a group, show a much greater liking for coffee flavor (high iced coffee, and flavor enhancement scores) than other ethnic groups (Rozin & Cines, in press).

Possible bases for distinguishing these two relatively independent "contexts" for coffee are:

(a) *Liquid-Solid*. It is notable that almost all of the coffee in the world is consumed in liquid (hot beverage) form. This also holds for tea, but is definitely not true for the third common source of xanthines, chocolate. It is striking that the extensive use of chocolate in solid form (e.g., confections) is not paralleled by coffee, given that both have very attractive aromas. However, given the lack of popularity of iced coffee and other coffee flavored beverages, it would seem more accurate to say that hot water, rather than liquid, is the preferred context for coffee.

(b) *Temperature*. Hot coffee is hot. None of the other vehicles for coffee flavor that we explored are hot. The temperature distinction neatly separates the highly liked form of coffee from the less liked forms showing low correlations with hot coffee liking. The major contrast in liking between hot and iced coffee and the low correlation of their hedonic ratings is best captured by the temperature difference.

(c) *Flavor Transformation*. The flavor and aroma of hot coffee beverage is quite different from that of other forms of coffee flavor. These differences, particularly the suppression of aroma in most coffee-flavored products, might be critical. Yet, a majority of our sample liked coffee in both brewed and instant forms, in spite of the marked suppression of aroma in the latter case. Another central factor in coffee flavor is bitterness. The majority of our subjects preferred coffee with cream and sugar. Though subjects show an impressively high degree of liking for coffee as drunk, there is a net dislike for black, unsweetened coffee. (Subjects rated the taste of black-unsweetened coffee on the nine-point hedonic scale. The mean ranking was only 3.70, compared with 8.35 for coffee as drunk.) This suggests that bitterness is not the critical variable in distinguishing hot coffee beverage and other forms of coffee flavor. In fact, most people seem to treat coffee in such a way as to minimize its bitterness. Although our data do not speak directly to this point, it is likely that individual differences in bitter sensitivity affect the additives used in coffee and possibly the relation between hot coffee liking and flavor enhancement (Hall, Bartoshuk, Cain, & Stevens, 1975).

(d) *Pharmacological Effects*. The caffeine in hot coffee is at higher levels than in other vehicles (except for iced coffee). This might explain the enhanced liking for hot coffee over other forms of coffee flavor (except iced coffee) but makes no clear prediction about the (very low) intercorrelations in liking between hot coffee and other forms of coffee flavor.

In summary, there is no single convincing explanation of the coffee flavor dissociation effect.

The other principal finding is a substantial relation between caffeine effects (morning effects and addiction scores) and liking for hot coffee. This relation does not hold for other forms of coffee flavor. We must emphasize that this is a correlation: it is conceivable that greater liking for coffee causes greater caffeine intake, which could lead to more addiction and possibly greater caffeine effects. (The latter would assume higher caffeine intakes per cup or more cups at a time, both questionable assumptions, to lead to greater caffeine effects in stronger likers.) It seems more likely that the greater effects play some causal role in the generation of liking.

The suggestion from the data of a particular potency for the calming-relaxing-nervousness-reducing caffeine effects in generating liking is puzzling. A major concern in the field of affect acquisition is the identification of those physiological changes that support affective change (Rozin, 1979; Rozin & Fallon, 1981). The main clue we have comes from the acquisition of aversions (negative affect) and it indicates that nausea and related upper gastro-intestinal events are critical in the production of negative affect change (Garcia, Hankins & Rusiniak, 1974; Rozin, 1979; Rozin & Fallon, 1981; Pelchat & Rozin, Note 1). These results might lead to the suggestion that positive gastrointestinal events had particular potency in positive affective changes. Our data do not support this suggestion. We did not monitor any gastro-intestinal effects of coffee, and note that the principal reported gastro-intestinal effect of coffee is probably heartburn (Cohen & Booth, 1975). However, in our collection of reasons for drinking coffee, many subjects claimed (or checked) that it fills them up. Subjects who offer this reason, either spontaneously or on the check list, do not show a significantly greater liking for hot coffee (Table 5).

These data are preliminary, and should only serve as a stimulant for further analysis of the role of specific effects in affect change. We remind the reader that the effects measure is based on verbal reports evaluating past experiences. Confirmation would be required from direct measures on subjects under caffeine, and their verbal reports at that time, as in the multiple approach to caffeine effects used by Goldstein and his colleagues (Goldstein & Kaiser, 1969; Goldstein *et al.*, 1969).

In summary, this study emphasizes the importance of context (e.g., vehicle) in the acquisition and generalization of likings. It also provides suggestive evidence that some pharmacological effects of caffeine may be a component in the acquisition of a liking for a common, somewhat bitter food.

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