Fine as North Dakota Wine:
Sensory Expectations and the Intake of Companion Foods

Brian Wansink [a,*], Collin R. Payne, [a] and Jill North[b]

[a] Nutritional Science and Applied Economics, Cornell University, Ithaca, NY 14853, USA

[b] Food Science and Human Nutrition, University of Illinois, Champaign, IL 61801, USA

[*] Corresponding author. 110 Warren Hall, Cornell University, Ithaca, NY 14853, USA. Tel.: +1 607 254 6302; fax: +1 607 255 4776. *E-mail address*: wansink@cornell.edu (B. Wansink). Thanks to James E. Painter for comments on an earlier draft of this manuscript.

Fine as North Dakota Wine:
Sensory Expectations and the Intake of Companion Foods

Abstract

Although taste expectations can influence taste evaluation, can such an environmental cue have a referred impact on the intake volume of companion foods? Adult diners who ordered a prix-fixe restaurant meal were given a complimentary glass of wine that had been relabeled to induce either favorable ("new from California") or unfavorable ("new from North Dakota") taste expectations. An analysis of plate waste indicated that those who believed they had been drinking California wine ate 12% more of their meal than those who instead believed they drank North Dakota wine. In combination with a sensory-based lab study, these results show that environmental cues – such as label-induced sensory expectations – can have a far-reaching impact on the food intake of companion foods.

Keywords: food intake, wine, sensory expectations, expectations, labels, taste ratings, sensory halo, halo, environmental cues, quality cues

1. Introduction

Taste expectations can dramatically bias sensory evaluations [1, 2]. These expectations can lead a person to focus on those aspects of taste that confirm (rather than disconfirm) their initial expectation of it [3-5]. Within limits, a food expected to taste good will taste good, and a food expected to taste bad will taste bad [6-8]. What is not known, however, is whether these expectations of one food can have a referred impact on the consumption of companion foods [9]. Investigating this impact on behavior will contribute to the growing interest in the environmental cues that indirectly encourage overconsumption and could contribute to obesity.

Consider the sensory-rich context of wine. The evaluation of wine is thought be somewhat subjective to the willing, but untrained palate [10]. As a result, it may be that various cues of quality, such as the origin, name, or label of a wine might influence expected taste. What is of interest is how these expectations would influence intake of it *and* of accompanying foods.

A wine that has won an award or is from a prestigious area such as the Bourdeaux region in France or from California's Napa Valley, might lead one to have favorable taste expectations. These expectations may lead a person to consume more wine and to enjoy the accompanying food more than they would if they had a less favorable taste expectation of a wine (such as if it was from North Dakota – the last American state to produce a commercial wine). Consider three supporting explanations that triangulate on how a confirmation bias, instigated by positive expectations of wine, could increase consumption of it and of accompanying foods.

First, positive taste expectations of a wine could lead to positive taste expectations of companion foods, which would lead to increased consumption for both. For example, if a served wine is perceived to be "high quality," an assumption may be that any food served with the "high quality" wine is likely to be of similar quality (because it might be thought that "high quality" wine is infrequently matched with a "low quality" food). As a consequence, people will search for and ultimately find confirmatory sensory qualities of both the wine and food ("this wine and food tastes great!"). Finding these positive qualities might encourage higher consumption of the wine and food than if initial expectations of the wine (and its accompanying food) were negative.

Second, positive taste expectations of a wine could lead to confirmatory sensory experiences of it ("this wine tastes great!"), leading to more wine intake, and less self-restraint. Decreases in self-restraint have commonly been linked to alcohol intake, which has been shown to increase food consumption [11]. Regardless, this increased intake would have initiated a biased search for confirmatory sensory evidence of the wine (confirmation bias).

Third, positive expectations of a wine could lead to confirmatory sensory experiences of the wine, food, and one's enjoyment of the aggregate experience ("this wine tastes great and I am having a great time!"). Increasing the level of enjoyment would lengthen one's mealtime, which – in turn – is correlated with intake [12, 13]. These three explanations all involve a biased search for confirmatory sensory evidence of the wine and this eventually influences food intake. In combination, all three possibilities suggest that positive expectations of a wine could encourage greater food consumption than will negative taste expectations.

2. Study 1 -- Pre-Intake Expectations and Post-Intake Evaluations

An IRB-approved pre-study of 49 graduate students (63% male; average age of 24.6) was first conducted to determine whether expectations generated from wine labels would bias one's subsequent taste of the wine and of a companion food (cheese). Upon arriving at an end-of-year wine and cheese reception, volunteer participants were randomly led to one of two tables on opposite sides of a large room. At one of the tables, participants were individually shown (by the hosts) an inexpensive bottle of Cabernet Sauvignon wine that was relabeled as being from California. Those graduate students led to the other table were shown the same wine that had instead been relabeled as being from North Dakota. The labels of "California" and "North Dakota" were printed in a bold, 20-point font (2.4 inches wide) so that they could be easily read. In addition, the colored labels on all of the bottles had been professionally designed and included a logo of a fictional winery named, "Noah's Winery."

After each participant was shown either the wine from "California" or "North Dakota," they rated how tasty [14] they expected the wine to be on a 9-point scale (1 = not very tasty; 9 = very tasty). Participants were then given one-half ounce (22 ml) of the wine (ostensibly from either "North Dakota" or "California") and a 1.8 cm square cube of unlabeled mild goat cheese. As they ate both, they were asked to rate how tasty both the wine and the cheese was on a 9-point scale (1 = not very tasty; 9 = very tasty). They were then thanked at which time they joined the reception.

3. Study 1 Results

Of the 49 participants, 5 did not want to drink the wine, 3 did not want to not eat the cheese, and 1 did not want to consume either. As illustrated in Figure 1, those who

believed a wine was from California had more favorable taste expectations than those drinking wine they believed was from North Dakota (5.14 vs. 2.76; t (47) = 5.9, $p < .01$). As expected, those in the California label condition subsequently rated the taste of both the wine (5.18 vs. 3.68, t (42) = 4.3, $p < .01$) and of the cheese (4.46 vs. 3.31; t (44) = 2.3, $p < .05$) as higher than those who believed they had drank wine from North Dakota.

[Insert Figure 1]

In general, these participants were novices with presumably untrained palates. When novices articulate their expectations (such as by writing down their expectation ratings prior to tasting a wine), it may lead to an experimentally-induced bias (a demand effect). Although people naturally create expectations of a food prior to eating it, we usually do not do so in such a salient and potentially obtrusive way [15]. While this study shows that there is a strong expectation-related bias in the lab, we do not know if this bias follows people to less obtrusive environments, such as when they dine out during the evening. For this reason, the main field experiment, Study 2, will focus on unobtrusive measures of consumption (food intake as calculated from plate waste). Such measures are not at risk for being biased by sensory expectation questions.

4. Study 2 -- Expectations and the Intake of Companion Foods

In total, 41 patrons dining at a restaurant at a large Midwestern university participated in this study, which was approved by the Institutional Review Board. Two patrons were not of legal drinking age and were not included in the study. This left 39

patrons (71% male; ages 23 to 71) who were served a glass of wine and who were included in the data analysis.[1]

The restaurant used in this study (the Spice Box at the University of Illinois at Urbana-Champaign) was concurrently being used for a university-approved fine-dining course. The restaurant was open one evening a week, and the prix-fixe menu included a pre-selected entrée of a starch and vegetable. On this evening, the prix-fixe meal was plated and pre-weighed so that researchers could calculate how much food was consumed by subtracting the weight of the remaining food from the initial weight of the entree. Patrons typically had a choice of beverages at the restaurant, but on the day of the study, a complimentary glass of wine and a glass of water was all that was provided.

Patrons arrived at the University restaurant from 5:30-7:30 p.m. during a winter evening in February (-3.4^{o}C). Although 66 reservations had been taken, 15 people were not able to keep their reservations, possibly due to the weather. According to the reservations they had made, patrons were seated in groups of two, three, four, or in one case, nine. Once seated, one of eight servers would approach the table and say, "Thank you for joining us tonight for this special meal at the Spice Box. Because this is the first meal of this new year, we are offering each person at the table a free glass of this new Cabernet from the state of California (or North Dakota)." Both labels included the name of "Noah's Winery" as the source of the wine. The server showed the bottle to each of the people at the table and then poured a predetermined amount of wine (114 milliliters)

[1] One of these patrons ate more than their pre-plated portion (i.e., leftovers from companions). To be able to use this patron's data, we did not include this additional amount of food in the analysis of grams consumed, but did include the total amount of grams that was possible to consume from this pre-plated meal (550 grams).

into each glass. He or she then said, "Please enjoy your complimentary glass of wine from California (or North Dakota)."

Each table was randomly assigned to receive either California- or North Dakota-labeled wine. Both the California- and North Dakota-labeled wine was the same inexpensive wine (Charles Shaw Winery -- $2.99 US). In total, eight different tables were given wine with the California label while eight other tables were given wine with the North Dakota label. If questions were asked of the server about the free wine, they simply said it was part of a promotion for a new winery. If patrons asked for additional wine, servers were instructed to tell patrons that the wine was complimentary and that the restaurant was not given enough bottles to generously serve more than just one glass per person.

Following their meal, their time of completion was noted and patrons were thanked for their patronage. After leaving the restaurant, their entrée was cleared from the table and taken to the kitchen where the weight of the remaining plate waste was recorded. Following this, the weight of the remaining wine was recorded.

5. Study 2 Results

5.1. The impact of wine labels on food consumption

To initially examine the impact of wine labels on food consumption patterns, independent sample *t*- tests were conducted between those patrons who had been served California-labeled wine and those who had been served North Dakota-labeled wine. Because the pilot study suggested that people's taste expectations were far greater for California-labeled wine than North Dakota-labeled wine, we believed that people

drinking California-labeled wine would drink *and* eat more than those drinking North Dakota-labeled wine. Indeed, patrons who were given California-labeled wine (compared to North Dakota-labeled wine) consumed more grams of their entrée (499.8 vs. 439.0_{gms}; t (37) = 2.1, p = .02). This was a 12% increase in food consumed compared to when patrons received a North Dakota labeled wine.

[Insert Table 1]

When combining the total grams of food and wine consumed, those who received a California-labeled wine also consumed more total grams (entrée and wine combined) during dinner than those receiving a North Dakota labeled wine (600.6_{gms} vs. 549.4_{gms}; t (37) = 1.8, p = .08). However, there were no differences in wine consumption across both conditions. As Table 1 indicates, most of the patrons in both conditions consumed nearly all of the wine given to them, t (37) = 1.52, p = n.s.

Those who were poured wine from bottles with California labels lingered at their tables for an average of 64.4 minutes (SD = 19.1) compared to the 54.9 minutes (SD = 12.6) spent eating by those who were given North Dakota wine. While this is a 17% increase in table time, it is not clear whether this difference in time can be attributed to a longer dining time or to a longer leisure time at the table. Furthermore, because most individuals leave a restaurant table simultaneously (12), when the analysis is conducted at the table level (n = 16) versus the individual level (n = 39), there is insufficient power for the results to be statistically significant.

5.2. Social facilitation as a potential confounding variable of grams eaten

In social environments, the amount of food one consumes can be influenced by one's eating companions [12]. In this study, it may be how much one ate or drank could be attributed to the people around them in addition to their expectations of the quality of the meal (their confirmation bias). To determine if this was the case, we created two new variables that would allow us to test for this possibility [16].

The first variable ("similarity") was created to account for the similarity of eating within tables. This was done by computing the inverse of the standard deviation of grams eaten by individuals at a particular table. Because we took the inverse of the standard deviation, higher values in this variable indicate how similar (rather than how different) consumption is within a particular table. To account for one-person tables, we fixed scores of these individuals in the "similarity" variable to zero, which represents no social facilitation of consumption. However, to be able to specifically test the situation where social facilitation could not occur (1 person at a table) and where it could occur (2 or more people at a table), we created a second variable.

The second variable ("alone") was created to account for the absence of social facilitation or when there was only 1 person eating at a particular table. Whereas the first variable ("similarity") was created to specifically account for how similar or different eating behavior was within a particular table, the second variable ("alone") was created to specifically account for the possibility of social facilitation. This was done by creating a dummy variable that simply coded participants as 0 (more than one person eating at a table) or 1 (1 person eating at a table).

The variables 1 ("similarity"), 2 ("alone": 0=two or more people; 1=one person), 3 ("state":1= ND; 2=CA), were simultaneously regressed on grams eaten along with

"time" (time spent eating) and "sex" (1=male; 2=female). Even after accounting for the for possible associated eating behavior within specific tables ("similarity"), and the possibility of social facilitation ("alone"), patrons still ate more when receiving a California labeled-wine in contrast to a North Dakota-labeled wine, $\beta_{state} = .38$, t (33) = 2.25, $p = .03$ (see Table 2). However, neither "similarity," $\beta_{similarity} = -.10$, t (33) = -.61, $p = .55$, "alone," $\beta_{alone} = .08$, t (33) = .47, $p = .64$, "time," $\beta_{time} = .01$, t (33) = .04, $p = .97$, nor "sex," $\beta_{sex} = .18$, t (33) = 1.04, $p = .31$, were found to uniquely predict grams of food eaten. In fact, when "similarity," "alone," "time," and "sex" are included in the multiple regression equation with "state," the overall model is not significant, $R^2 = .16$, F (5, 33) = 1.2, $p = .34$.

[Insert Table 2]

A similar analysis was then done with the total grams consumed (food plus wine), and similar results were found. When controlling for possible associated eating behavior within specific tables ("similarity"), the possibility of social facilitation ("alone") and other potential confounding variables ("time" and "sex"), the perceived source of the wine predicted total consumption better than any other variable, $\beta_{state} = .33$, t (33) = -1.8, $p = .08$ (see Table 2). However, neither "similarity," $\beta_{similarity} = -.13$, t (33) = -.71, $p = .48$, "alone," $\beta_{alone} = .10$, t (33) = .56, $p = .58$, "time," $\beta_{time} = .03$, t (33) = .14, $p = .89$, nor "sex," $\beta_{sex} = .17$, t (33) = .98, $p = .34$, were found to uniquely predict grams of food eaten. In fact, when "similarity," "alone," "time," and "sex" are included in the multiple regression equation with "state," the overall model is not significant, $R^2 = .12$, F (5, 33) = .92, $p = .48$.

6. Discussion

These findings not only underscore how expectations influence one's taste ratings of an accompanying food (Study 1), they also show how these expectations influence its consumption (Study 2). These two studies suggest how a confirmation bias – instigated by positive expectations based on a quality cue – could increase consumption of a target food and of a companion food.

Environmental cues of quality, such as a wine label, may provide a positive expectation for not only the wine but for accompanying food as well. Based on these expectations, as long as the wine or food were not radically different from expectations of taste [8], patrons may believe the wine and food to be better and subsequently drink and eat more of it. As reported, patrons who were given California labeled wine (as compared to North Dakota labeled wine) generally consumed more total grams during dinner and, specifically, more grams of their entree.

While evidence of this confirmation bias supports the results for food intake, the results for wine intake do not. However, there was a restricted range of how much wine a patron was allowed to drink (one glass). Patrons may have drunk more wine as a function of wine quality cues (CA label) had they been offered the opportunity.

Favorable expectations generated by wine labels could encourage more wine intake, which could lead to less self-restraint and more food intake [11]. Since patrons were offered a restricted amount of wine, further research could lift this ceiling. Allowing for unconstrained wine intake could result in a more sensitive test for understanding if variations in the amount of wine consumed is related to consuming more or less of food because of increased or decreased inhibitions. At least in this study, increased food intake was suggested to be related to higher expectations of wine (created by cues of a

303 wine's quality) and not significantly decreasing inhibitions because patrons were
304 restricted to one glass of wine.
305 Favorable expectations created from cues of a wine's quality could also favorably
306 increase expectations of one's dining experience and subsequently lengthen one's
307 mealtime. In a wide range of studies, increased enjoyment with one's dining experience
308 has been shown to be correlated with intake [3]. When examining the amount of time
309 eating dinner, those who believed they were drinking wine from California stayed nearly
310 ten minutes longer for dinner than those who believed they were drinking wine from
311 North Dakota (64.4 vs. 54.9 minutes). This suggests that possibility of high expectations
312 of wine influencing one's enjoyment of the meal resulting in longer meal times.
313
314 **6.1. Limitations and Future Research**
315 We measured taste expectations and taste experiences with wine and cheese in
316 Study 1 by asking participants to indicate how "tasty" they expected the wine to be, how
317 "tasty" the wine actually was, and how "tasty" the cheese was. Our intent in using the
318 term "tasty" was to obtain a global evaluation of the gustatory expectation and experience
319 with the wine and cheese. This intent may not have been realized. That is "tasty" can
320 have a number of interpretations other than what we intended. "Tasty" can also refer to
321 flavor, which is the combination of gustatory and olfactory experiences with food. Also,
322 "tasty" can refer to affective judgments of a food based upon its flavor. Thus, "tasty"
323 may not be a pure evaluation of a person's gustatory experience with a food.
324 Nevertheless, the term "tasty" does not exclude gustatory experiences with food, but
325 better gustatory evaluative terms could be used in future research.

In order to unobtrusively examine food intake, the decision was made to conduct the expectation measurement study independently of the intake study. As a result, Study 1 provides evidence of the expectation and evaluation bias, while Study 2 provides evidence of the intake bias. Similarly, it was believed that a post-hoc measurement of initial expectations (one that followed food consumption) might not be an accurate reflection of pre-consumption expectations of wine. Although these patrons received complimentary wine, another way that expectations could have been manipulated is through the price of a wine. While this would be a realistic scenario for a restaurant, such a procedure would have created a selection bias in the lab. Those people who bought the less expensive wine might be very different than those willing to spend more money on a glass.

An important issue with all field studies is how social facilitation might influence behavior. In Study 2, social facilitation (as measured by similarity of eating) did not overshadow the influence on expectations on consumption. This is not to say that social facilitation does not play an important part in food consumption, but rather it was not a major influence in this study about expectations. This study included tables of 1 (n = 4), 2 (n = 8), 3 (n = 1), 4 (n = 1), and 9 (n = 1). Further research could include larger samples to understand how consumption can be influenced by the interplay between social facilitation and environmental cues (wine labels) that lead to confirming (rather than disconfirming) expectations about a wine and a companion food.

6.2. Conclusion

It is well known that physiology influences how much we eat. In addition to physiology, psychological processes may also influence how much we eat [4, 17].

Expectations piqued by environmental cues can have a referred impact on companion food intake that has not previously been expected. Environmental cues, such as the label on a wine bottle, may bias how much one consumes of companion foods during a meal.

These cues of quality can take many forms, including price, labels, appearance, or name. Furthermore, it might be that even unrelated atmospheric cues – such as ambience, lighting, and sounds – can creative expectations and generate an intake bias. Our ever-widening awareness of the range, form, and impact of these environmental cues will become increasingly useful in helping us better predict and improve our behavior as it relates to food intake.

References

[1] Cardello AV, Maller O, Masor HB, Dubose C, Edelman B. Role of consumer expectancies in the acceptance of novel foods. J Food Sci 1985;50(6):1707.

[2] Rozin P, Dow S, Moscovitch M, Rajaram S. 1998. What causes humans to begin and end a meal? A role for memory for what has been eaten, as evidenced by a study of multiple meal eating in amnesic patients. Psychol Sci 9:392-396.

[3] Wansink, B. Environmental Factors that Increase the Food Intake and Consumption Volume of Unknowing Consumers. Annu Rev Nutr 2004:24:455-479.

[4] Wansink B, Park SB. Sensory suggestiveness and labeling: do soy labels bias taste? J Sens Stud 2002;17(5): 483-491

[5] Wason, PC. On the failure to eliminate hypotheses in a conceptual task. Q J Exp Psychol 1960;12:129-140.

[6] Cardello AV. Consumer expectations and their role in food acceptance. In: MacFie HJH, Thomson, DMH, eds. Measurement of Food Preferences. London: Blackie Academic; 1994:253-297.

[7] Tuorila, H.M., Meiselman, H.L., Bell, R., Cardello, A.V., & Johnson, W. Role of sensory and cognitive information in the enhancement of certainty and liking for novel and familiar foods. Appetite 1994;23:231-246.

[8] Tuorila HM, Meiselman HL, Cardello, AV, Lesher LL. Effect of expectations and the definition of product category on acceptance of unfamiliar foods. Food Qual Preference 1998;9(6):421-430.

[9] Cardello AV, Schutz H, Snow C, Lesher, L. Predictors of food acceptance, consumption and satisfaction in specific eating situations. Food Qual Preference 2000;11(3):201-216.

[10] Charters S, Pettigrew S. Is wine consumption an aesthetic experience? J Wine Res 2005;16(2):121-136.

[11] Baumeister RF, Heatherton TF. Self-regulation failure: an overview. Psychol Inq 1996;7(1): 1-15.

[12] De Castro JM. Social facilitation of duration and size but no rate of the spontaneous meal intake of humans. Physiol Behav 1990;47(6):1129-1135.

[13] Rozin P, Tuorila H. 1993. Simultaneous and temporal contextual influences on food acceptance. Food Qual. Pref. 4:11-20.

[14] Caton SJ, Marks JE, Hetherington MM. Pleasure and alcohol: manipulating pleasantness and the acute effects of alcohol on food intake. Physiol Behav 2005;84: 371-377.

[15] Schifferstein HNJ, Kole APW, Mojet, J. Asymmetry in the disconfirmation of expectations for natural yogurt. Appetite 1999;32:307-29.

[16] Cohen J. A power primer. Psychol Bull 1992;112(1): 155-159.

[17] Richardson PS, Dick AS, Jain AK. Extrinsic and intrinsic cue effects on perceptions of store brand quality. J Mark 1994;58(4): 28-36.

Table 1. Descriptive Wine Labels Influence Food Intake
(Standard Deviations in Parentheses)

	Diners Given Wine with a "California" Label (n = 24)	Diners Given Wine with a "North Dakota" Label (n = 15)	t - value
Entrée Consumed (gms)	499.8 (87.2)	439.0 (89.2)	2.1**
Wine Consumed (gms)	100.8 (23.3)	110.4 (9.0)	-1.5
Total Consumption (gms)*	600.6 (84.9)	549.4 (90.2)	1.8*

* $p < .10$; ** $p < .05$

Table 2. California and North Dakota Wine Labels Uniquely Predict Consumption
(Standardized Beta Weights)

	State (ND/CA)	Similarity	Alone	Time	Sex	R^2
Entrée Consumed (g)	.38**	-.15	.10	.01	.18	.16
Total Consumption (g)	.33*	-.13	.10	.03	.17	.12

*p < .10; **p < .05

Figure 1. Wine Labels Can Bias Expectations and Tastiness Ratings of Both Wine and Cheese