Just Taste It:

Expectations, Experience, and their Timing as Determinants of Preferences

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Abstract

We examine two of the ways, direct and indirect, by which knowledge can influence preferences. In three experiments, patrons of a pub sampled and expressed their preferences between beer and beer with balsamic vinegar. The results showed preference for the vinegar-brew was lowest for those told upfront about the vinegar, and higher for those who were either unaware of the vinegar altogether, or informed about the vinegar after tasting the beers but before expressing their preferences. These results suggest that knowledge influences preference by modifying sensation (the indirect path). A fourth experiment demonstrates that respondents do not intuit the effect of information timing on preference.
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Cognitive psychologists have long understood that the phenomenology of experience is governed by both perceptual inputs arising in our sense organs (“bottom up processes”) and conceptual inputs arising in our brain, which can influence the processing or eventual interpretation of sensory input (“top down processes”).

One well-known example illustrating both top-down and bottom-up processes is presented in Figure 1. This ambiguous figure, originally published in Harper's Weekly (Nov. 19, 1892), may be perceived as either a rabbit (facing left) or a duck (facing right), depending on whether the concept of rabbits or ducks is made accessible before viewing (Jastrow, 1899; Tsal & Kolbet, 1985). Such evidence supports the top-down process by showing that the same retinal stimulus can give rise to different perceptual experiences depending on the observer’s expectations. At the same time, it also supports the bottom-up process by showing the limits to such influences. Though plausibly interpretable as a rabbit or duck (or a hair dryer or drill), this “ambiguous” image will not be interpreted as a giraffe, a triangle, or Ronald Reagan, no matter how accessible such concepts are made in the higher cortical areas responsible for interpreting the retinal signal. Other examples that illustrate the joint effects of the bottom-up and top-down processes include evidence that the context of a visual scene strongly influences the speed and accuracy with which embedded objects are perceived (Biederman, 1972; Palmer, 1975), and that letters presented in the context of a word are more quickly recognized than those presented in isolation (Neisser, 1967).

*** Figure 1 ***
The top-down vs. bottom-up distinctions can also be applied to analyses of preferences. For example, one’s consumption of food (and perhaps one’s perception of the way it tastes) is influenced by the actual chemical properties of the food, but also by the beliefs about other aspects of the food, including its nutritional properties or brand (Braun, 1999; Levin & Gaeth, 1988). For example, McClure et. al. (2004) found that Coke consumed from a cup labeled Coke was generally preferred to Coke consumed from an unlabeled cup (which respondents presumably thought was not Coke). They also found, in an fMRI study that if an image of a can of Coke was presented prior to its oral delivery (a squirt of Coke in the mouth), several brain areas were more highly activated than if Coke was consumed without this prior visual information regarding the identity of the sweet fluid being squirted into their mouth.

The study by McClure et. al. (2004) is one of many showing that top down processes (e.g. information of brand identity) affect food preferences (Allison & Uhl, 1964; Bowen et. al., 1992; Levin & Gaeth, 1988). However, despite this research, it is, as yet, unclear whether conceptual inputs affect preferences directly as a separate input, independent from the taste experience (Figure 2A), whether it modifies the taste experience itself (Figure 2B), or whether it affects preferences in both ways (as illustrated in Figure 2C).

For example, although the study by McClure et. al (2004) shows that brand knowledge activates brain structures not activated by the chemical contents of cola, it does not resolve whether the preference for the substance definitively identified as Coke occurs because the positive associations of the name provide a positive independent input for preferences (Figure 1).
2A), or whether the taste per se is affected by the information (Figure 2B). The same ambiguity is evident in an earlier study by Allison and Uhl (1964), where 326 male beer drinkers sampled their favorite brand of beer and four other brands. When the beers were not labeled, all five brands received nearly identical taste ratings. However, when the drinkers knew which beers they were consuming, their favorite brand was rated significantly higher. Here, it is again unclear whether the elevated ratings reflected an enhanced gustatory experience per se, or whether the label information was another input causing consumers’ to rate their preferred brands higher. As a third example, Bowen et al. (1992) found that consumers ate more ice cream if it was labeled as “high fat.” Again, these results permit alternate interpretations. Perhaps high fat is associated with high quality and people are more willing to consume high quality treats (Figure 2A), or perhaps the high fat label enhances taste expectations, which in turn enhances the taste experience, leading to greater consumption (Figure 2B).

**Experimental Approach**

In three experiments, we attempted to determine which conceptualization of the top-down process best characterizes the manner in which knowledge influences preferences. In all three experiments, respondents consumed two beer samples: one unadulterated sample, and one sample of the “MIT brew,” which contained a few drops of balsamic vinegar—a beer condiment that most participants find conceptually offensive, but which does not, at this concentration, negatively influence the taste of beer (in fact, it slightly improves it). After tasting the two beer samples, respondents indicated their preference between them in a manner that varied across the

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2 To verify this assumption, we asked 121 patrons of *The Muddy Charles* to assess how beer would taste if balsamic vinegar were added, on a scale ranging from -10 (much worse), to +10 (much better). Eighty percent of the respondents expected that balsamic vinegar would make the beer taste worse. The mean rating was -4.03, which is significantly below 0 \(F(1,119) = 22.45, p < 0.01\).
three experiments. The difference between the three conditions was based on the information that respondents received about the beer and the timing of this information (see Figure 3). In the blind condition, respondents tasted the two samples without any information about their contents. In the before condition, respondents were told which beer contained the balsamic vinegar, before tasting either. In the after condition, respondents first tasted the beers as in the blind condition, and were then told (after tasting) which contained the balsamic vinegar.

Collectively, these three conditions can test the general effect of top down processes and more importantly, distinguish whether the path by which knowledge influences preferences is the direct or indirect one. A comparison of the blind and before conditions would reveal how disclosure of the secret ingredient affects preferences towards the sample containing it, via either the direct or indirect pathway. If the preference for the MIT brew is lower in the blind relative to the before condition, this would mean that the information about the balsamic vinegar adds positively to the evaluation, and if the preference for the MIT brew is higher in the blind relative to the before condition, this would mean that the information about the balsamic vinegar adds negatively to the evaluation. Since all the three models (see figure 2) predict an influence of knowledge on preferences, a difference between the before and blind conditions would not be informative as to the path by which knowledge influences preferences.

If we take the difference between the before and blind conditions as defining the range of possible influence of knowledge on preferences in this case, the relative preference for the MIT brew in the after condition would help us distinguish between the direct and indirect paths. The degree to which preference for the MIT brew is similar in the after and before conditions and different from the blind condition would reveal whether preferences are affected by the direct
route alone. Similarly, the degree to which preference for the MIT brew is similar in the after and blind conditions and different from the before condition would reveal whether preferences are affected by the indirect route alone (the degree to which consumers’ conceptual aversion influences the gustatory experience itself).

In summary, if preferences are driven primarily by the bottom up process, there should be little difference among the three conditions. If the influence of the top down process is via the direct path, preference for the MIT brew should be markedly lower in the before and after conditions compared with the blind condition. If the influence of the top down process is via the indirect path, preference for the MIT brew should be markedly lower in the before condition than the blind and after conditions.

Experiments 1-3: Preferences

Our first three experiments were conducted at two local pubs: The Muddy Charles and The Thirsty Ear. Patrons were approached and asked to participate in a short study involving free beer. Those who agreed (nearly everyone) tasted two 2-oz. samples of beer: “regular” beer (Budweiser or Samuel Adams)\(^3\) and the “MIT brew.” In the case of Budweiser, the “MIT brew” included the same beer plus four drops of balsamic vinegar per 2-oz. In the case of Samuel Adams, the “MIT brew” included the same beer plus six drops of balsamic vinegar per 2-oz (since this was a stronger beer and more balsamic vinegar was needed to distinguish the beers from each other).

There were 388 participants in total (90 in Experiment 1, 139 in Experiment 2, and 159 in Experiment 3). In each experiment, participants were randomly assigned to one of three

\(^3\) Budweiser was used in the first two experiments and Sam Adams in the third. We switched after discovering that Budweiser is not a very popular beer among our participants, many of whom even disputed whether it deserves to be called a “beer.”
experimental conditions ("blind," "before," and "after"). After tasting the two samples, respondents indicated their preference between them (see Figure 3). The main difference across the three experiments was the dependent measure. In Experiment 1, participants were simply asked to indicate which of the two samples they liked more. In Experiment 2, they indicated for which of the two samples they would like a full (10-oz) glass. In Experiment 3, participants in the before and after conditions received a full (10-oz) glass of regular beer, some balsamic vinegar, a dropper, and the "secret recipe" ("Add 3 drops of balsamic vinegar per ounce and stir"). We monitored whether (and how much) balsamic vinegar participants actually added to their beer, and used this to code their preference between the two beer types. It turned out that all participants added either the exact amount of balsamic vinegar specified by the recipe or none at all, creating a binary dependent measure.

Results

As can be seen in Figure 4, across the three experiments, the preference for the MIT brew was higher in the blind conditions (59%) than in the before conditions (30%), indicating the role of top down influences. The effect was significant overall \[F(1, 385) = 23.15, p < 0.01\], and for each of the three experiments separately (all \(p < 0.01\)).

More importantly, the preference for the MIT brew in the after condition was only slightly lower than in the blind condition, a difference that was not significant, either overall across the three experiments [59% vs. 52%, \(F(1, 385) = 1.17, p = 0.28\)], or in any of the experiments individually (all \(ps > 0.42\)). In contrast, preference for the MIT brew was significantly higher in the after condition than the before condition overall [52% vs. 30%, \(F(1, 385) = 13.84, p < 0.01\), as well as for each of the experiments individually (all \(ps < 0.04\)). These
results suggest that the top-down process exerts its influence on preference primarily via the indirect path—by affecting the taste experience itself.

Together, these results suggest that participants did not summarily reject the concept of vinegar in their beer (as was evidenced by their willingness to choose the beer they knew contained balsamic vinegar in the after condition). Instead, the conceptual offensiveness of the notion of balsamic vinegar in beer altered the gustatory experience of consuming the sample containing it. In other words, beer tastes bad when participants know it contains vinegar. These results concur with the findings by Levin and Gaeth (1988), who found that respondents who tasted a sample of freshly cooked ground beef just after they were (falsely) told that it contained 25% fat rated the beef slightly (though not significantly) less favorably than those who were told about the fat content after tasting the beef. It is possible that Levin and Gaeth (1988) failed to find a significant difference because the presence of fat in ground beef may not be widely regarded as a bad thing (at least as far as its flavor was concerned.)

*** Figure 4 ***

**Experiment 4: Lay Theories**

Our mothers often used creative labeling to trick us into eating something they knew we would otherwise find conceptually offensive (e.g. by calling crab cakes “sea hamburgers” and rice pudding “granular pudding”). They knew such deception was required to gain our consent, but they also knew that they need not maintain the lie after we had consumed the foods, and would often debrief us afterwards, with smug satisfaction (“By the way, son, in case you were wondering, “sea” means “crab” and those granular objects are grains of rice.”). They suspected (correctly in most cases) that we could not “handle the truth” before eating, but could handle it

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4 The description in this section is based on the biographical memory of one of the authors, who deeply loves his mother despite her occasional mistakes regarding her son’s ability to handle the truth.
after our senses had signaled that this was good stuff. Perhaps our mothers could have predicted our results? To test whether our mothers are especially clever intuitive psychologists, or we are unusually naïve ones, we described the procedure used in Experiment 2 to thirty-four MIT students, and asked them to predict the choice share of the MIT brew in each of the three conditions (blind, before, and after).

Results

As can be seen in Figure 5, our respondents recognized that preexisting concepts can play a large role in influencing preferences. They correctly predicted that the MIT brew would be preferred much less often in the before condition than the blind condition (19% vs. 32%; \( F(1, 99) = 11.01, p < 0.01 \)). However, they also predicted that the preference for the MIT brew would be reduced by the same degree in the after condition, which was not true. Thus, in the language we have been using, these results suggest that respondents’ lay theory emphasizes direct top down processes over indirect ones, contrary to fact in this case. (It is also worth noting that our respondents incorrectly assumed that a few drops of balsamic vinegar would make beer worse, even in the blind condition, when, in fact, it made it better.)

General Discussion

The current work focuses on the relative importance of, and interaction between, two different bases for preferences: knowledge (top down) and experience (bottom up). In particular, we examined whether and how knowledge of a conceptually offensive additive would affect preferences toward the product containing it. The results across three experiments suggest that the indirect path is more important. Information about the presence of a conceptually offensive
ingredient influences preferences more when received before consumption than when received after consumption. In other words, one’s liking of MIT brew is substantially lower when it is known to contain balsamic vinegar than if one learns it contained balsamic vinegar. Indeed, in the experiments, learning that a particular beer sample contained balsamic vinegar hardly diminished the preference for it at all (there were no significant differences between the blind and after conditions).

Obviously, the conclusions about the relative importance of the direct vs. indirect top down processes will vary across domains. The direct path may be more important if the additive was something that was widely known as bad, but which had no negative connotations regarding taste (e.g. cyanide). Presumably, top down processes occasionally operate via both direct and indirect routes, and may have been the case in our experiments as well, since preferences for the MIT brew were consistently lower in the after condition than in the blind condition, though not significantly so.

The evidence regarding the indirect influence of the top-down process on preferences raises several additional questions. First, how important is the temporal interval between sensory experience, other information, and judgment? In our experiments, the information in the after condition was provided immediately after the tasting experience. As soon as respondents had finished consuming the two beer samples, they were told which contained balsamic vinegar. As noted, this information did not markedly affect evaluations of the MIT brew relative to the blind condition. By contrast, Braun (1999) found that when respondents who had previously consumed diluted orange juice tainted with vinegar were later told it was “sweet, pulpy, and pure,” their subsequent evaluations were markedly influenced. Her results may differ from ours because in our studies, the interval between sensory input and the judgment was quite short (less than a
minute, typically), whereas in her study, the misleading information was presented 30 minutes or more after the consumption experience. This time delay between the experience and the information may have diminished the clarity of the memory for the unpleasant experience, and thereby reduced the weight it received in the subsequent evaluations.

A second issue raised by these experiments is the speed with which conceptual attitudes align with experiences? If we are coerced or tricked into discovering that we actually enjoy some unusual food (rice pudding), food additive (balsamic vinegar), or sexual practice (fill in the blank), do we eagerly consume it at the next opportunity, or do our prior expectations linger, despite their disconfirmation. In a study by Tuorilla, Lesher and Cardillo (1994), respondents were allowed to taste normal or fat free versions of saltine crackers or pound cake. Although their expectations that the fat free products would taste worse was disconfirmed upon trial, when they came back to the lab a month later, they retained their original negative impressions of fat free crackers and pound cake. Similarly, in our experiments, preferences converged with experiences after only a single trial: only 20% held favorable evaluations of balsamic vinegar beforehand, but 52% preferred the MIT brew in the after condition. Yet, it is unclear whether respondents who preferred the MIT brew in the after condition would continue preferring it (or perhaps even demanding it) on subsequent visits to the pub. In some cases, a single positive taste experience may be sufficient to permanently quash initial conceptions, but for others, a lingering suspicion of a negative conception may remain and gradually regain ascendance over fading taste memories.

A third unresolved challenge is to understand the various perceptual, attentional, and cognitive mechanisms that may contribute to the indirect influence of the top-down process on preferences, and to understand the exact psychological or physiological mechanisms at work.
There are multiple candidates, ranging from anticipatory changes in the receptor cells, increased sensitivity and attention, or biased information search in ambiguous experiences. In an experiment supporting the biased search account, Hoch and Ha (1986) found that the ultimate evaluation of a J.C. Penny polo shirt was more favorable if participants were told the shirt was made with “great craftsmanship, styling and meticulous quality control” before they physically examined that shirt (and the shirts of competing brands), than if those claims were presented afterward. They suggest that the brand specific claims induced respondents to devote more time inspecting the J.C. Penney shirt, searching for information that confirmed the product claims. Our respondents did not likely spend more time consuming the MIT brew, searching for negative aspects of the experience, but, they may well have interpreted their ambiguous beer experience (some combination of wet, bitter, sweet, sour, carbonated, and malty) differently in the presence of knowledge of their contents. When told of the secret ingredient, they may have focused on the negative aspects of that multidimensional experience, and falsely attributed those negative elements to the vinegar rather than the beer.

As the questions above illustrate, the relative influence of perceptual and conceptual inputs on overall evaluations is likely to be sensitive to the timing of the information, the timing of the judgment, the particular domain, and the range of sensory and cognitive processes engaged by the particular instructions of the task. We are not, for example, confident that our results uncovered a market opportunity to sell pocket sized packets of balsamic vinegar to pub patrons. But, we are confident that this experimental design and variants thereof will prove intellectually profitable in the pursuit of an understanding of preference construction.
References


Figure Captions

Figure 1: The rabbit-duck ambiguous figure, known also as Jastrow's cartoon, was based on one originally published in Harper's Weekly (Nov. 19, 1892, p. 1114).

Figure 2: A graphical illustration of the two paths by which the top-down process can influence preference formation. Panel A represents the direct path from knowledge to evaluation. Panel B represents the indirect path from knowledge via sensation to evaluation. Panel C represents both direct and indirect paths.

Figure 3: A graphical illustration of the manipulation of information timing (relative to tasting and preference indication) across the three conditions (blind, before, and after).

Figure 4: Percentage of respondents indicating preference for the MIT brew across the three conditions in Experiments 1-3.

Figure 5: Predicted choice share of the MIT brew across the three conditions (blind, knowledgeable, and later knowledge) in Experiment 4. Error bars are based on standard errors.
Figure 1
Figure 2

A) Knowledge → Evaluation

Sensation

B) Knowledge
→ Evaluation

Sensation

C) Knowledge
→ Evaluation

Sensation
Figure 4

% preference for MIT brew

Exp 1  Exp 2  Exp 3

60  70  63
50  41  47
23  43

Blind  Before  After
Figure 5

% of MIT brew choice

Blind: 32.4
Before: 18.7
After: 20.9