



## **A Network of Food Preferences**

June 21, 2010

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### Abstract

Using more than 500,000 responses to Hunch's THAY (Teach Hunch About You) questions I construct a network of paired preferences for breads, cheeses, beers, fries, and salad greens. Sub-mappings show the best beer- and fries- combinations as well as recipes for well-matched sandwiches. I explain methodologies of basic network analysis as well as previous attempts at mapping food-related preferences.

### Aperitif

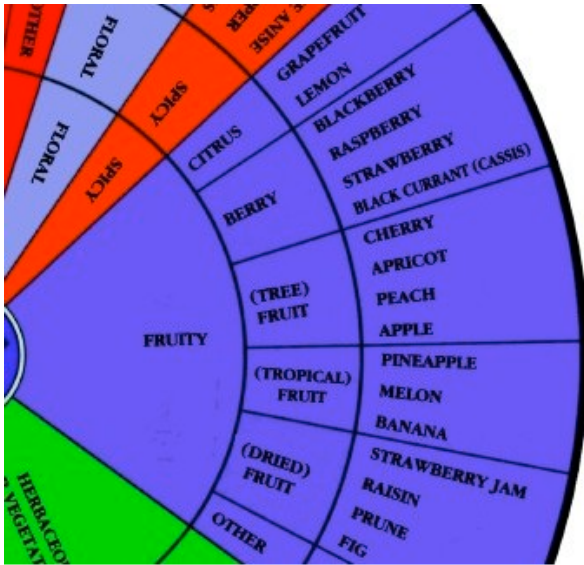
Tomatoes and basil. Mussels and Belgian beer. Coffee and a bagel. Pairing foods is a culinary pastime unto itself. Some combinations (peanut butter and jelly) are too classic to be called into question, while some (dill and mango sorbet, for example) are restricted to the bravest of souls and brashest of taste buds.

What if we could create a mapping of all the foods and flavors that pair well together -- a chart of the entire known world (of scents)? A number of researchers have endeavored to do just that, measuring flavors in everything from beer to perfume.



[1618 map of the known world](#)

A well-known wine aroma wheel was developed by [Ann Noble at UC Davis](#) and measures the sensory (rather than molecular) distances between different flavors present in wine. Cut green grass is not too far from bell pepper and eucalyptus, whereas sauerkraut tastes an awful lot like sweat and yogurt.



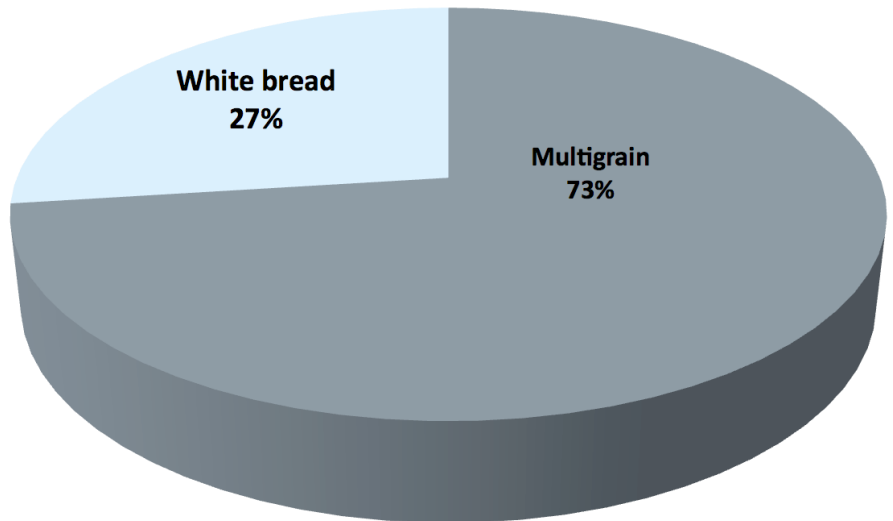
Other scientists have sought to map chemical relationships: Haddad develop a metric for comparing smells using a 1664-long sequence describing odorant molecules which [correlate well with neural responses to the different scents](#).

## How Hunch Lunches

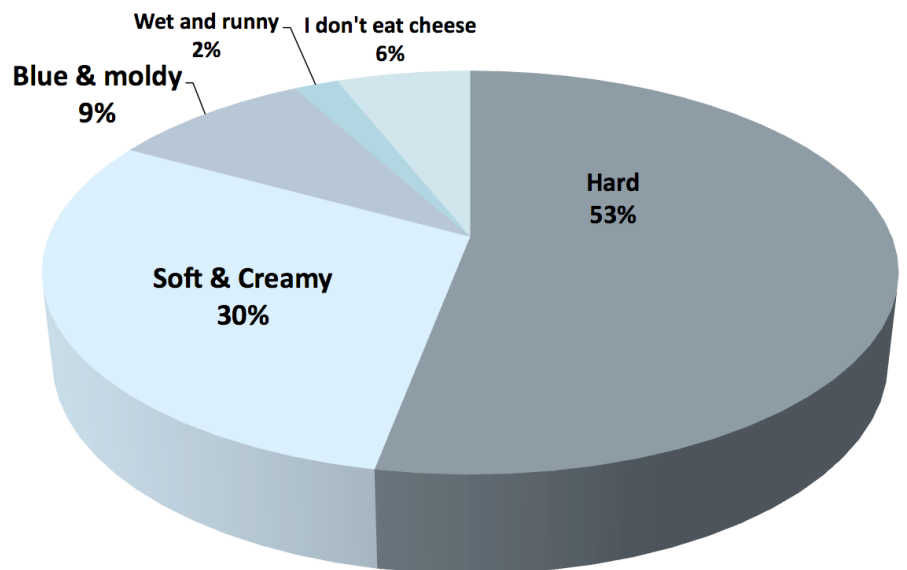
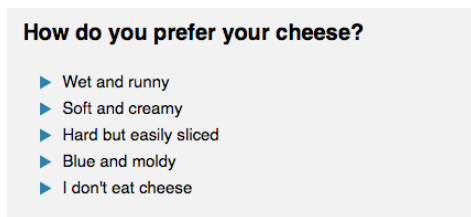
There are more than [550 topics on Hunch related to food and drink](#), and dozens of Teach Hunch About You (THAY) questions on Hunch related to food and drink. Some 200,000 people have revealed their preferences about at least two of the following food categories based on THAY questions:

- Bread
- Cheese
- Lettuce
- French Fries
- Beer

In each THAY question, respondents picked from a handful of choices, which typically described the sub-categories rather than specific varieties or brands (that is, “hoppy beers” rather than “Harpoon IPA”). The specific questions as they appear on Hunch and responses (as pie charts) are as follows:

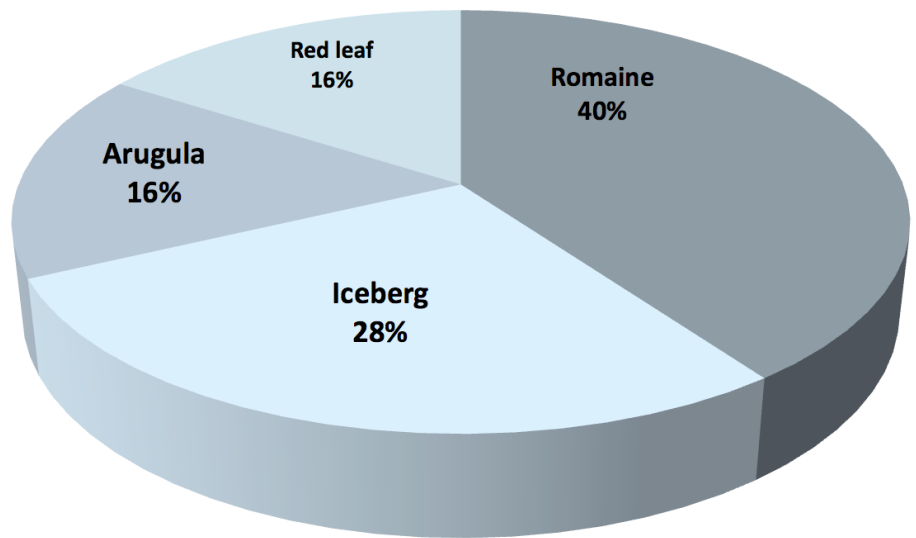


Among 195,902 Hunch users. Margin of error is 1%



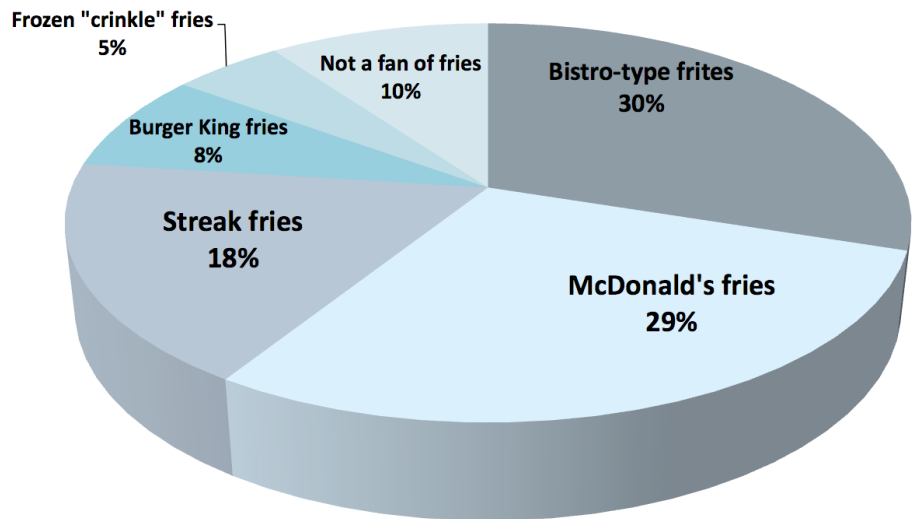
Among 13,266 Hunch users. Margin of error is 1%

Which of these lettuces would you usually prefer on a salad?



Among 126,148 Hunch users. Margin of error is 1%

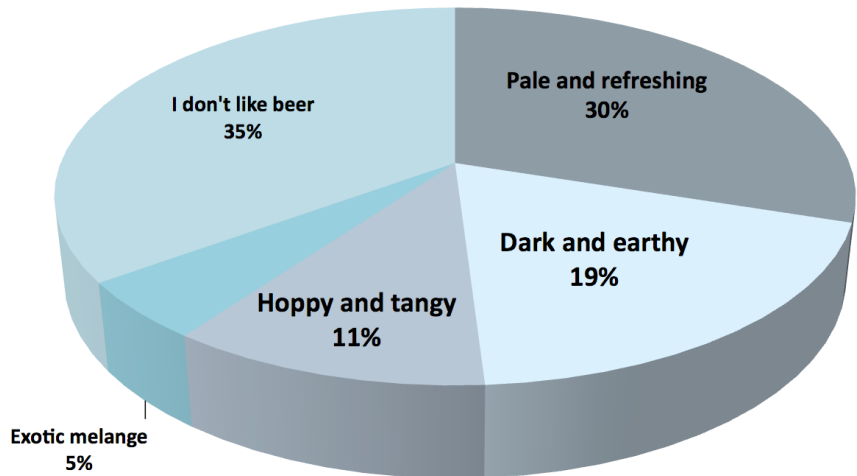
Which fries would you prefer to munch?



Among 195,930 Hunch users. Margin of error is 1%

## Is your favorite beer:

- ▶ Pale and refreshing
- ▶ Dark and earthy
- ▶ Hoppy and tangy
- ▶ An exotic melange
- ▶ I don't like beer



Among 9,073 Hunch users. Margin of error is 1%

You'll probably notice a sampling bias here. For example, even though 73% of people who answered the Hunch question prefer multi-grain bread, the figure for America as a whole is much lower: sales of white bread [accounted for about 45% of total bread sold in 2005](#), whereas whole grain bread make up only 27%.

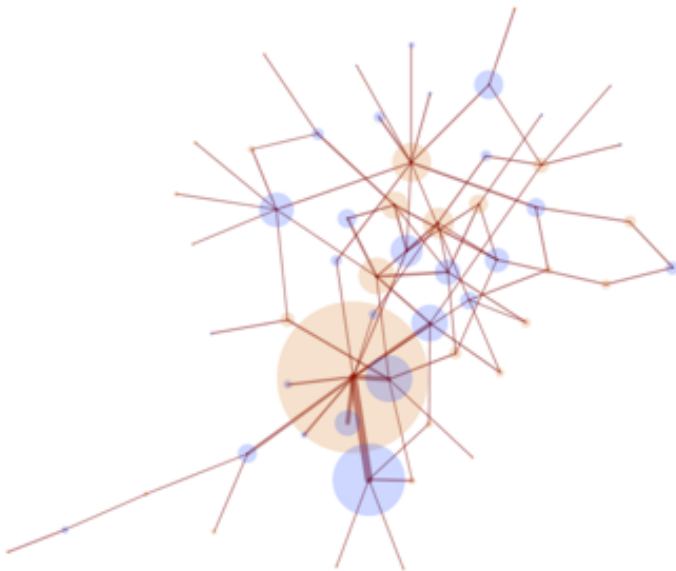
In order to build a network of preferences, we must look at the pair-wise probabilities that someone will favor an element from each of two different categories. Put another way, what is the chance that you'll choose both multi-grain bread and blue cheese, or white bread and hard cheese? (Turns out it's about 7% and 14%, respectively)

	Multi-grain	White	Total
Blue and moldy	7%	1%	8%
Hard but easily sliced	40%	14%	54%
I don't eat cheese	4%	2%	6%
Soft and creamy	21%	9%	30%
Wet and runny	1%	1%	2%
Total	73%	27%	100%

Next, we'd like to display all of these probabilities together as a network or map of preferences. The next section presents a brief introduction to network analysis.

## The Science of Networks

A network is a model of items (called *nodes*) and the relationships between them (*links* or *edges*). Nodes can be anything from people or molecules to abstract concepts. In recent years, networks have been used to model everything from [groups of friends](#) to the [relationships between diseases](#). It's been shown, for example, that communities transfer information most efficiently via "small world" networks: just a few well-connected individuals can allow new ideas to spread quickly.



Network of email discussions, with participants (blue) and threads (orange).

Credit: [Anders Sandberg](#).

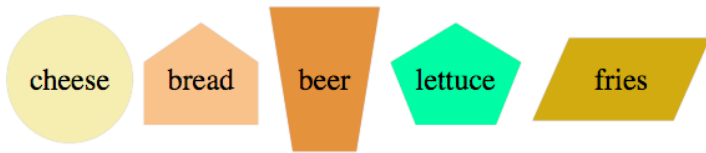
Typical measures of networks include the degree of connectivity, the clustering of links around different nodes, and the extent to which a node is central to the network. Each of these measures can tell us something about the relationships between entities.

In the preference map below, nodes represent food items and links the percentage of Hunch users who chose two items as their favorites. Every type of food node – beer, bread, cheese, lettuce, and fries – has a different associated icon. The weights of edges are given by the percentage of Hunch users within a food pair (e.g. beer and cheese) who prefers a specific combination. These percentages are additionally normalized to account for the different numbers of possible responses

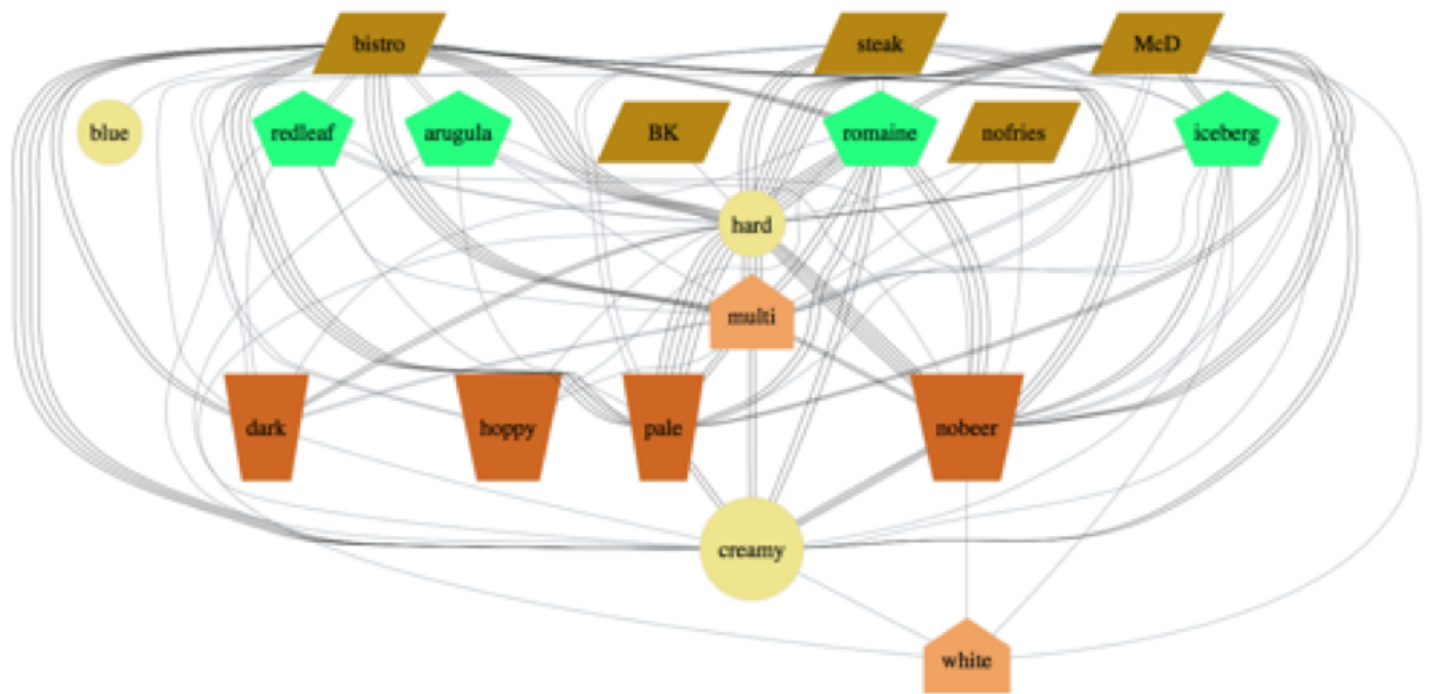
# hunch

for each question (for example, two kinds of bread versus six types of fries). In addition, I use an algorithm to structure the network such that two nodes with a strong connection (that is, a large percentage of people favoring that combination) are closer together.

Key:



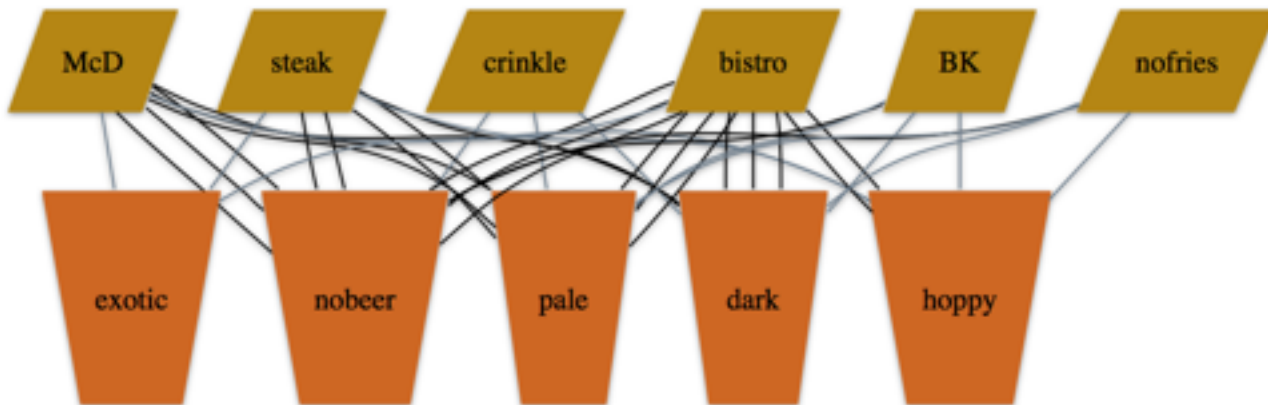
Relationships:



The visualization includes only combinations preferred by at least 10% of users (normalized). Thus, frozen “crinkly” fries, runny cheese, and exotic beers do not make it onto the chart at all. The strength of the links can be observed in the darkness and number of lines connecting any two nodes, and in the relative proximity of two nodes to each other. Thus, people who like bistro fries are most likely to prefer hard cheese, but they are also more likely to prefer creamy cheese than a McDonald’s fries fan would be (there are 4 lines between bistro-frites and creamy cheese, but only 2 between McDonald’s fries and creamy cheese).

## Fries & Beer

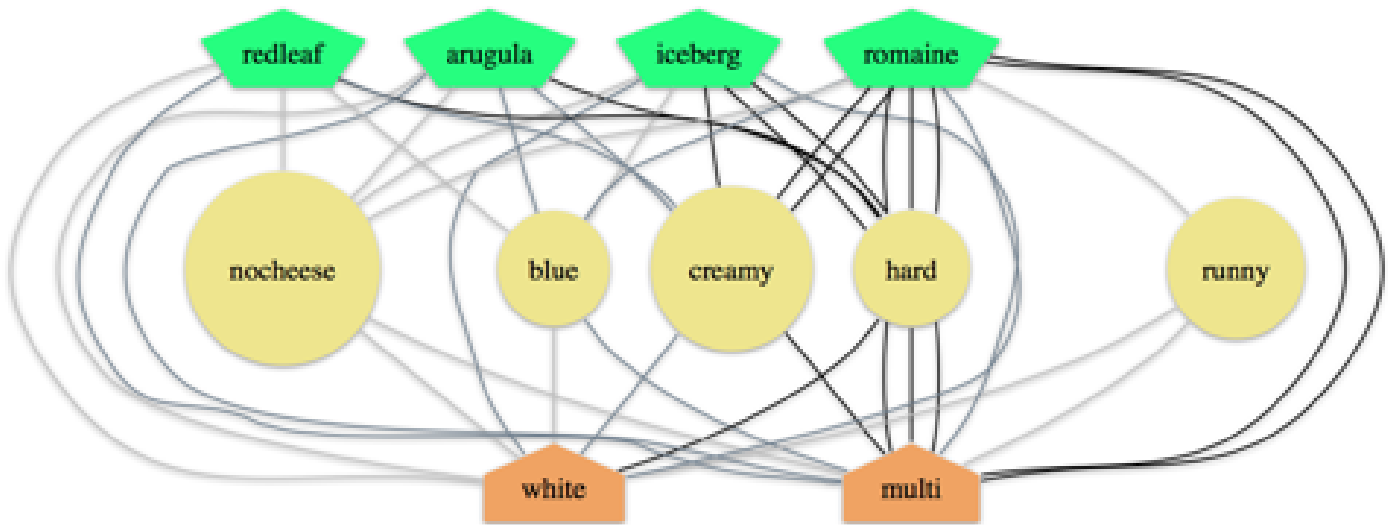
So, we've arrived at the critical question: what kind of fries should you order with that beer? If you're to trust the crowd, you might pair steak fries with pale ale, or bistro fries with dark ale, or McDonald's with no beer at all. Of course, you may have your own established preferences: how common is your pairing compared to those of Hunch users overall?



We have intuitive notions of what goes well with what: note that this visualization doesn't necessarily represent which beers go well with which fries, but rather which fries are preferred by people who like a particular beer. Nevertheless, it shows clusters of different demographics who happen to like the same things: a restaurant might use such a mapping to determine its menu combinations in order to cater to different tastes. (side note: Burger King must have done its research, because in the [limited locations where they are testing beer on the menu](#), they're serving Miller and Budweiser – just the type of pale beers which are most closely associated with the chain's fries.) Of course, you could also try asking the local brewery if you can BYOF (Bring Your Own Fries).

## The Perfect Sandwich

Let's now turn our attention to the perfect sandwich. While almost 3 times as many Hunch users chose multi-grain bread to white, the normalized values give us more resolution on the cheeses that pair better, comparatively, with white. People who don't eat cheese prefer wheat bread by a factor of 2 to 1, whereas blue cheese aficionados take the whole grain stuff over white with a ratio of 7 to 1.



So if you want to make a crowd-pleasing sandwich, remember that on the whole people prefer hard cheese, romaine lettuce and multigrain bread. However, if you come across someone who professes a love for moldy cheese, you might serve him a sandwich with arugula. On the other hand, when your friend tells you he likes redleaf lettuce (and your friend is a Hunch user), it's a fair bet that he'll also be partial to white bread.

## Digestif

Some portion of preference is beyond our control, as a result of genetic and environmental interaction ([cilantro abhorrence](#), [peanut allergy](#), type II diabetes). But much of what we like is learned.

Experiments with rats show that preference can be socially mediated: smell something on your friend's breath, and you're more likely to find a subsequent taste pleasing. So, it's not surprising to see clusters of taste, nor would it be alarming to discover that some of these clusters correspond to pre-existing social or cultural groups.

While a complete map of taste may remain far off, there's strong evidence that we can begin to quantify how one set of preferences relates to another. Your love of bistro fries might be subjective, romantic, and even unrequited, but it's far from unpredictable, given your opinions about Pale Ales.

If you've enjoyed this report and are still hungry for more, try some of the [food-related topics on Hunch](#) or [explore additional Hunch reports](#).



## Methodology and disclaimers

Hunch personalizes the internet by learning about each individual in order to provide customized recommendations on nearly any topic. More than 55 million THAY ("Teach Hunch About You") questions have been answered since Hunch was publicly launched in June 2009. Selected THAY responses comprise the bulk of this report's analysis.

It should be noted that Hunch is not a professional research organization and this data was not collected in a scientifically rigorous manner. Sampling bias is likely because 1) data is collected only from people who elect to use the Hunch website and 2) responses are recorded only from those users who elect to answer a given question.

This and other Hunch reports are available in HTML and pdf formats at [www.hunch.com/info/reports](http://www.hunch.com/info/reports).

For more information or questions please contact: Kelly Ford, Hunch Inc., [kford@hunch.com](mailto:kford@hunch.com).