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Are There Fundamental Laws of Cooking?

By Samuel Arbesman ✉ January 19, 2012 | 11:55 am | Categories: Science Blogs, Social Dimension

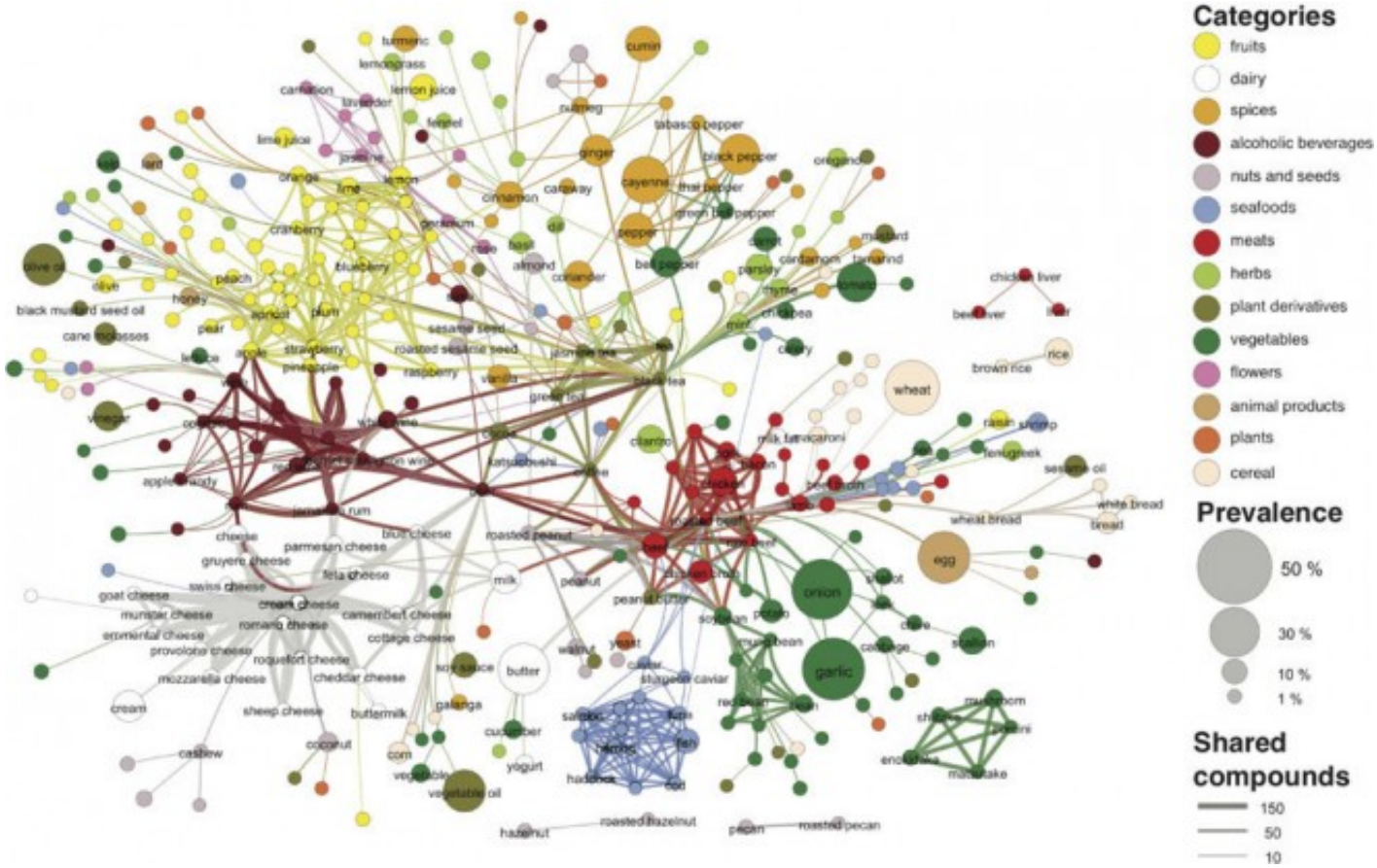
Cooking is a field that has in recent years seen a shift from the artistic to the scientific. While there are certainly still subjective and somewhat impenetrable qualities to one's cuisine — *de gustibus non est disputandum* — there is an increasing rigor in the kitchen. From molecular gastronomy to *Modernist Cuisine*, there is a rapid growth in the science of cooking.

And mathematics is also becoming part of this. For example, Michael Ruhlman has explored how certain ingredient ratios can allow one to be more creative while cooking. Therefore, it should come as no surprise that we can go further, and even use a bit of network science, when it comes to thinking about food.

Yong-Yeol Ahn and his colleagues, in a recent paper titled Flavor network and the principles of food pairing, explored the components of cooking ingredients in different regional cuisines. In doing so, they were able to rigorously examine a recent claim: the food pairing hypothesis. The food pairing hypothesis is the idea that foods that go best together contain similar molecular components. While this sounds elegant, Ahn and his collaborators set out to determine whether or not this is true.

Using recipes from such websites as Epicurious, the researchers examined more than 50,000 recipes. They combined these recipe data with information about the chemical components in each of the ingredients, in order to create a network map of related ingredients. For example, shrimp and parmesan are connected in the network,

because they contain the same flavor compounds, such as 1-penten-3-ol. A large flavor network of different ingredients is below.



Once they constructed this network of related ingredients, the authors were able to test the food pairing hypothesis. And they found that it was true, at least when it came to Western cooking. North American and Western European cuisines, which share many of the same ingredients, both adhere to the food pairing hypothesis: Foods in the same recipe often have the same underlying molecular components. However, once we stray from these cuisines, the food pairing hypothesis breaks down. East Asian and Southern European recipes use ingredients that do not overlap in their flavor compounds, implying that these styles of cooking are in fact quantitatively distinct. So, while mathematical rigor can be applied to different types of cooking — the scientists also discovered that Latin American cooking is halfway between Southern European and East Asian — the food pairing hypothesis is not the Grand Unified Theory of Food it had been hoped.

Of course, there do seem to be certain flavor invariants, even if the food pairing hypothesis has gone by the wayside. Witness the Incompatible Food Triad. The incompatible food triad is the search for three foods that are acceptable when paired separately but when all combined together are terrible. For example,

An example solution would be three pizza toppings — A, B, and C — such that a pizza with A and B is good, and a pizza with A and C is good, and a pizza with B and C is good, but a pizza with A, B, and C is bad. Or you might find three different spices or other ingredients which do not go together in some recipe yet any pair of them is fine.

The fundamental law though in this case is that this is impossible: There is no such triad! At least it seems this way; it might not be true. Perhaps food is much more an art than something that can be ruled by theorems. Especially once we consider such "delicacies" as surströmming, it becomes difficult to conceive of mathematical invariants in the food world. In the end, it might be that the only regularity we can count on is the Periodic Table of Meat.

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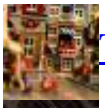
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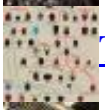
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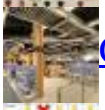
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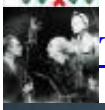
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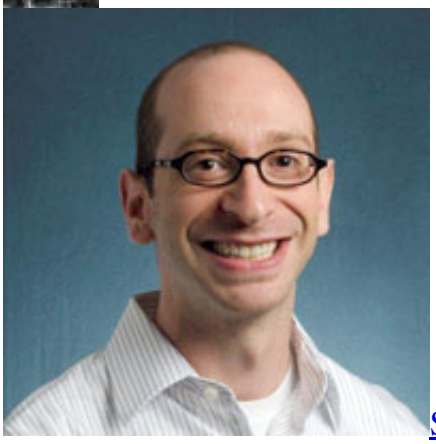
Samuel Arbesman is a senior scholar at the Ewing Marion Kauffman Foundation. You can follow Sam on Twitter, where he talks about math, society, and pop culture. Follow @arbesman on Twitter.

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