Gastrophysics: a new scientific approach to eating

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ABSTRACT

In recent years, a growing number of researchers, working in a range of different scientific disciplines, have become increasingly interested in the application of science to gastronomy. Several terms or movements have been introduced to capture different elements of this interface between science and food/flavour: the focus of molecular gastronomy research, for instance, is on the science behind the delivery of delicious food; the focus of neurogastronomy research, meanwhile, is on what is going on in the mind of the diner; finally, the focus of gastrophysics (at least according to the definition given here) is on the interface between gastronomy and psychophysics (the measurement branch of perception science).

All three approaches, operating at the interface between science and culinary artistry, can be seen as providing useful (and non-redundant) insights/approaches that will hopefully help to enhance the delivery of delicious food experiences. At the same time, the focus for many of those working in these disciplines is increasingly around how to nudge the consumer toward healthier and/or more pleasurable food choices that are more sustainable, be that for the individual or the planet.

Introduction

The last half century has seen growing interest in science in the kitchen (see Spence & Piqueras-Fiszman, 2014; and Spence & Youssef, 2018, for reviews). Three prominent strands of this interaction/collaboration are molecular gastronomy, neurogastronomy, and gastrophysics, and these (non-redundant) movements are briefly summarized below.

Molecular gastronomy

Molecular gastronomy has been defined as 'the science of deliciousness' (e.g., Barham, Skibsted, Bredie, Bom Frøst, Møller, Risbo, Snitkjær, & Mortensen, 2010; Edwards-Stuart, 2012; see also Youssef, 2013). Early advocates for the application of science in the kitchen include Nikolas Kurti, Harold McGee, and Hervé This (e.g., Kurti, 1969; McGee 1984/2004, 1990; Kurti & This-Benckhard, 1994a, b). However, as highlighted by Spence and Youssef (2018), while molecular gastronomy has undoubtedly provided inspiration for chefs both in terms of novel preparation methods as well as a range of new ingredients, its influence on chefs has been more in terms of inspiration rather than, as is sometimes claimed, the adoption of the scientific method by chefs. It is worth noting that molecular gastronomy has been taken up more by some chefs/countries than others. At the same time, the scientific approach to cooking has been adopted for more than two decades in cookery schools (e.g., in France) to help improve chefs' understanding of food transformation.

Neurogastronomy

A neoglism apparently coined by Gordon Shepherd in 2006 (see Shepherd, 2006). The term has become popularized following the publication of the latter's book *Neurogastronomy* (Shepherd, 2012). An annual neurogastronomy meeting, first held in North America in 2015, has helped to cement interest in this 'brain-based' approach. The approach is undoubtedly important, and has helped shed light on the fundamental mechanisms underlying feeding behaviour (Chen, Papies, & Barsalou, 2016), as well as shedding light on a number of long-running debates around such issues as how branding and price information change our sensory-discriminative and hedonic responses to foods (see Spence, 2016, for a review). That said, it is worth highlighting the fact the majority of research in this area involves participants lying by themselves in an often-noisy brain scanner, with liquid flavour stimuli being pumped into their

mouth that they are periodically instructed to swallow, meaning that the research context is far removed from the more social aspects of everyday/naturalistic dining on real foods/meals.

Gastrophysics

Gastrophysics has been defined in a number of ways since the term's original fleeting first appearance in an article by Kathy Parker (2004) in the journal Physical Education. Ole Mouritsen and colleagues have stressed the links with physical chemisty (e.g., Mouritsen, 2012; Mouritsen & Risbo, 2013, 2015). Spence (2017), by contrast, in his book, *Gastrophysics: The new science of eating*, emphasizes the combination of gastronomy and psychophysics that is at the heart of an emerging body of research focusing more on what is going on in the mind (rather than the mouth) of the person doing the tasting. While the former definition can be seen as close to molecular gastronomy, that is, it is science related to the preparation of the food itself, there are a growing number of researchers interested in the science of the mind of the diner too. That is, gastrophysics highlights the shift in focus from the science of the kitchen (i.e., of new foams, spumes, cooking techniques, and ingredients) to the science of the (mind of the) diner (i.e., the person consuming that food or drink).

Importantly, much of the focus of gastrophysics, at least according to this latter definition, is on 'the everything else' except the food itself. There has, for instance, been growing interest in the way in which cutlery (e.g., Spence & Piqueras-Fiszman, 2014; Welch, Youssef, & Spence, 2016) influence the diner's tasting experience, not to mention their eating behaviour. Similarly, there has been a recent explosion of interest in the psychological and physico-chemical aspects of glassware (i.e., going beyond the wine glass; e.g., Carvalho & Spence, 2018; Manska, 2018; see Spence & Wan, 2015, for a review). There is also growing interest in the multisensory atmosphere in the places in which we eat and drink, and how the ambient sensory cues may affect us (e.g., Spence, Velasco, & Knoeferle, 2014; and see Spence, 2017, for a review), building on early work by the likes of Edwards (e.g., Edwards, Meiselman, Edwards, & Lesher, 2003).

One of the other areas where there have been significant advances and interest in the world of gastrophysics is around a scientific approach to the art of plating (see Deroy, Michel, Piqueras-Fiszman, & Spence, 2014; Spence, Piqueras-Fiszman, Michel, & Deroy, 2014, for reviews). It is clear that the visual appearance of the food is playing an increasingly important role in people's food behaviours (see Spence, Okajima, Cheok, Petit, & Michel, 2016). In one example

of the gastrophysics approach, chef Charles Michel and his colleagues scientifically investigated how the plating of a salad impacted people's willingness to pay and enjoyment of the dish (Michel, Velasco, Gatti, & Spence, 2014). They were able to demonstrate, both in the laboratory and in a real-world dining event (Michel, Velasco, Fraemohs, & Spence, 2015), that people rate the same food at tasting better, and are willing to pay more for it, when it was plated beautifully/artistically (see **Figure 1**).

Figure 1. Three versions of the same plated ingredients (a 31 element salad) served to participants/diners in a gastrophsyics study of plating reported by Michel et al. (2014). Diners were willing to pay more for the Kandinsky-inspired presentation (A) than for the regular tossed version (B) or the ordered (i.e., effortful) but unaesthetic plating arrangement (C).

Conclusions

After three decades or so of science being applied in the kitchen (acknowledging, of course, that science has sporadically been applied in the kitchen at various points over the centuries) there is now a growing awareness that the pleasures of the table reside as much in the mind as in the mouth. As such, a new scientific approach is needed, one that moves beyond and builds upon traditional sensory science techniques and/or molecular gastronomy approaches to the design of delicious food. This new approach, here referred to as gastrophysics, emphasizes the importance of managing (and understanding) people's expectations as well as their experiences and subsequent memories (see Piqueras-Fiszman & Spence, 2015; Spence, in press). As highlighted here, this new gastrophysics is as interested in how 'the everything else' beyond the food or drink itself impacts the customer experience.

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