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Introducing the Perfect Meal

“Once at least in the life of every human, whether he be brute or trembling daffodil, comes a moment of complete gastronomic satisfaction. It is, I am sure, as much a matter of spirit as of body. Everything is right; nothing jars. There is a kind of harmony, with every sensation and emotion melted into one chord of well-being.”
(Fisher 2005, p. 325)

1.1 Introduction

This is a book about the perfect meal and how to get it, or at least how to get closer to it: not in the sense of the chef travelling to the furthest corners of the globe in the search for the über-unusual and extreme of culinary delights (Bourdain 2002)¹; nor in the behavioural economist’s sense of trying to optimize the benefits, while minimizing the costs, of the financial transaction that is dining out (Cowen 2012); and nor does this book offer a chef’s guide to, or search for, perfection as seen through the lens of molecular gastronomy or (better said) modernist cuisine (Blumenthal 2007; see also Rayner 2008). Rather, this is a book about how the latest insights from a diverse range of fields of research that include experimental psychology, design, neuroscience, sensory marketing, behavioural economics and the culinary and sensory sciences can, and in some cases already are, being used by a number of the

¹ Note that this interest in the unusual extends all the way from the celebrity chef though to the home dining setting. For example, Baumann (1996, p. 121) talks about the popular desire for “*not just ordinary cookbooks, but collections of ever more refined, exotic, out-of-this-world, ... recipes; promises of taste-bud delights never experienced before.*”

world's top chefs in order to deliver multisensory dining experiences that are more sensational, more enjoyable and consequently more memorable than anything that has ever gone before.

“What is ‘real’? How do you define ‘real’? If you are talking about what you can feel, what you can smell, what you can taste and see then ‘real’ is simply electrical signals interpreted by your brain.” (Morpheus in *The Matrix*; see Haden 2005, p. 354)

Here we are talking about experiences that are based on the emerging insights concerning the mind of the diner and not just on the whims and intuitions of the chef, or increasingly the culinary team, beaver away behind the scenes in many of the world's top restaurants (Spence 2013). It is our contention that, in the years to come, the search for the perfect meal will be facilitated as much by knowing about the mind of the diner and what makes it tick as it will by gaining further insights into the physiology of the human flavour system or by sourcing the most seasonal of ingredients and knowing how best to prepare (and present) them on the plate (Pollan 2006). The revolutionary new approach to the science of the perfect meal that we wish to showcase here is called ‘gastrophysics’. Before immersing ourselves in it, let's take a look back over the evolution of gastronomic movements and trends that has led to our current culinary practices and food knowledge.

1.2 A brief history of culinary movements

Over the last half century or so there have been a couple of major culinary movements that have left their indelible mark on the way in which we think about food today. The first of these was *Nouvelle Cuisine* which emerged in France during the 1960s. In the early 1990s, molecular gastronomy arrived with a bang (often literally). Let's take a brief look at these movements in order to get a better sense of the culinary landscape in which we find ourselves today.

“Periods of gastronomic change are inevitably periods of gastronomic controversy. When there is no controversy, there is no inventiveness, because controversy of course doesn't appear if there is no tension between tradition and innovation, or the other way, between innovation and academic conventions.” (Revel 1985, on the introduction of the *Nouvelle Cuisine*)

1.2.1 Nouvelle Cuisine

The term itself dates from the 1730s–1740s when French writers used it to describe a break with the traditional way of cooking and presenting foods (Hyman and Hyman 1999). However, the culinary movement that now bears

the name really took on a life of its own in the 1960s when the French food critics Christian Millau and Henri Gault used the term to describe the new culinary style that was then just starting to make its appearance in the kitchens of some of France's top chefs. Nowadays, the term *nouvelle cuisine* is used to refer to the use of seasonal ingredients with a focus on natural flavours, light textures (e.g. sauces that have not been thickened by the addition of flour and fat) together with a visual aesthetic that focuses on a presentation that is both simple and elegant (see Chapter 4). The French chefs who were instrumental in developing this new type of cuisine, including Paul Bocuse and Jean and Pierre Troisgros, were undoubtedly influenced by the minimalist Japanese style that placed a value on serving smaller portions. Indeed, the opening of the first French culinary school in Japan in 1960 by chef Shizuo Tsuji resulted in a much greater cultural exchange between Japanese and leading French chefs, including Paul Bocuse and Alain Chapel. The latter also embraced the use of ingredients sourced from many different parts of the world. In fact, this is also why it was so natural for *nouvelle cuisine* to morph seamlessly into 'fusion' food.

"Really, the concern with how the food looked can be traced back to the emergence of nouvelle cuisine. The pictures of these dishes have set themselves in the mind of the public. Nouvelle cuisine was essentially photogenic ... Think of the glorious coloured photographs of these dishes, which have become eponymous with the purveying of recipes." (Halligan 1990, p. 121)

It was precisely this emphasis on the visual appearance of food that led Alexander Cockburn, in a 1977 article that appeared in the *New York Review of Books*, to introduce the term 'gastroporn'.² This term, which has now made it into the Collins English Dictionary, is defined as 'the representation of food in a highly sensual manner'. It should therefore be noted that even food writing can qualify for this epithet.

1.2.2 The rise of molecular gastronomy

There can be no doubt that the fusion of the physical sciences with culinary artistry has fundamentally changed the fine dining landscape over the last couple of decades or so (Belasco 2006; Roosth 2013) and has been enthusiastically covered in the press under the title of 'molecular gastronomy'. This revolutionary new approach to cuisine is one that has attracted a phenomenal amount of media interest from pretty much every corner of the developed world (see Barham *et al.* 2010). The term itself was first coined by the Oxford-based Hungarian physicist Nicholas Kurti (who back in 1969 gave a

² Cockburn memorably described one of Paul Bocuse's cookbooks as a 'costly [...] exercise in gastro-porn' (cited in Poole 2012, p. 59).

presentation at the Royal Institute in London entitled *The Physicist in the Kitchen*; see Kurti 1969; Kurti and Kurti 1988). Particularly influential here was also a paper that Kurti wrote together with the French physical chemist Hervé This in the popular science magazine *Scientific American* (Kurti and This-Benckhard 1994a, b).

But what exactly is molecular gastronomy? McGee (1984) talks in terms of “*the scientific study of deliciousness*”. Perhaps a more precise, albeit less grammatical, definition comes from Roosth (2013, p. 4) who describes it as “*a food movement whose practitioners – chemists who study food and chefs who apply their results – define [sic] as the application of the scientific method and laboratory apparatuses [sic] to further cooking.*”

Nowadays, there is certainly a bewildering array of new techniques and ingredients, some natural, others much more artificial/processed,³ available to the budding modernist chef, no matter whether operating in the restaurant or home environment (e.g. see Blumenthal 2008; Myhrvold and Young 2011; Youssef 2013). Harold McGee, the brilliant North American author on kitchen science, has written a number of influential books in which he explores the science underpinning the practice of molecular gastronomy (McGee 1984; 1990). There he investigates such things as culinary proverbs, sayings and old wives’ tales. He has done more than perhaps anyone else to explore the physics and chemistry that lie behind a host of everyday culinary phenomena such as, for example, the Maillard reaction (McGee 1990).⁴

Fortunately for us there are already many great chefs and eminent scientists, not to mention flavour houses, working on the physics and chemistry of flavour (e.g. Barham 2000; Alícia and elBullitaller 2006; Konings 2009; Barham *et al.* 2010; Chartier 2012; Humphries 2012). We are therefore not going to cover these aspects of molecular gastronomy in any detail in this book (see McGee 1990; This 2005, 2012, 2013, for detailed coverage of this theme). We will, however, be taking a closer look at some of the most intriguing dishes to have emerged from these modernist kitchens over the last couple of decades. We will discuss some of the legendary dishes from the elBulli restaurant in Spain and The Fat Duck in Bray (UK). We’re going to dissect a number of the dishes from the Chicago School of Restaurants; think Grant Achatz’s Alinea and Homaro Cantu’s Moto. We’ll also be taking a look at a few of the dishes championed by those innovative new restaurants that have sprung up across Spain in recent years (part of *la nueva cocina* movement; Lubow 2003; Steinberger 2010). However, our interest in discussing many of these amazing dishes will not be the culinary magic underlying the preparation of the ingredients on the plate, but rather to try and understand some of the key psychological

³ In fact, it is all those unnatural ingredients, all the colorants, gelling agents, emulsifiers, acidifiers and taste enhancers that has led some authors to suggest, not entirely ironically, that the menus at molecular gastronomy restaurants ought to carry a health warning because of all the additives that they contain (Campbell 2009).

⁴ Named after the French doctor Louis-Camille Maillard who “*discovered that when amino acids are heated in the company of sugar, the reaction produces hundreds of new molecules that give cooked food its characteristic color and much of its smell.*” (Pollan 2013, p. 88).

and neuroscientific principles that lie behind the wonderful experience of eating them. And having got a handle on these fundamental insights, the challenge will then be to demonstrate how they can be used in everyday life, for example, to provide tips to help any one of us eat a little more healthily without having to compromise on the sensory pleasure of the experience.

1.2.3 Molecular gastronomy or modernist cuisine?

A number of the chefs with whom we collaborate most closely have something of a love/hate relationship with the term ‘molecular gastronomy’ (e.g. Blumenthal and McGee 2006; McGee 2006; Rayner 2006; Blumenthal 2008; Gopnik 2011). In fact, many of those working in the field would much rather have you refer to what they do as ‘modernist cuisine’. There are a number of reasons behind this terminological debate that are perhaps worth mentioning here. First, many chefs object to the term ‘molecular gastronomy’ because they feel that what has been happening in the kitchen in recent years is about so much more than merely playing with molecules, films, foams (or *espumas* as the Spanish like to call them) and gels, etc. In the pages that follow, you’ll see this is a view with which we most wholeheartedly agree.

What is more, many of those working in this area are also sensitive to the criticism that what they deliver can be seen as nothing more than a form of elitist cuisine. This notion, at least to those who worry about such things, is strengthened by the term ‘gastronomy’.⁵ As Heston Blumenthal put it in an interview back in 2006:

“Molecular makes it sound complicated ... and gastronomy makes it sound elitist ... We may use modern thickeners, sugar substitutes, enzymes, liquid nitrogen, sous vide, dehydration and other non-traditional means but these do not define our cooking. They are a few of the many tools that we are fortunate to have available as we strive to make delicious and stimulating dishes” (Rayner 2006)

The preference among many of those practitioners working in the kitchen is therefore for the more inclusive and less overtly chemical label of ‘modernist cuisine’.

What with so much baggage associated with the term ‘molecular gastronomy’, it should perhaps come as little surprise that Myhrvold and Young (2011), in what *The Independent* newspaper described as “*the most spectacular cookbook the world has ever seen*” (Walsh 2011, p. 11), chose to title their 3000-page masterpiece *Modernist Cuisine*. This 5-volume shelf-filler is undoubtedly a veritable feast for the eyes, detailing with absolutely stunning photography pretty much every tool and technique of the new art and science of the table (those with an addiction to gastroporn take note). That said, ‘molecular gastronomy’ would appear to be the term that has stuck in the

⁵ In his classic volume *The Physiology of Taste*, the French polymath Jean Anthelme Brillat-Savarin (1835) defined gastronomy as “*the reasoned knowledge concerning all aspects of food*”.

public consciousness. Indeed, a quick search on Google Scholar on 24 August 2013 brought up 1080 hits for the term ‘molecular gastronomy’ as compared to just 123 for ‘modernist cuisine’. Furthermore, many other up-and-coming young chefs such as Josef Youssef (who like many others trained for a while in the kitchens of The Fat Duck) appear to have no qualms about using the term ‘molecular’ (as Youssef himself does in the title for his new book; see Youssef 2013).

Deciding on the right name for this global culinary movement would seem to be a debate that is going to run and run. As such, we trust that you will forgive us for using the two terms fairly interchangeably in this book, although we also acknowledge the fact that ‘molecular gastronomy’ fails to capture many of the most important innovations that have permeated the research kitchens of some of the world’s top restaurants over the last few years (see also McGee 2006; Schira 2011).⁶

In the pages that follow, we will repeatedly see how many of the most interesting things that have been going on recently in the world’s top restaurants are about so much more than merely innovative food chemistry (especially in the area of novel gelling agents such as methylcellulose, xanthan gum and alginate) and kitchen technology (here we are thinking of devices such as the RotoVap, Pacojet, Thermomix and Gastrovac). Rather, the table of the future will likely involve the delivery of marketable (and hence branded)⁷ multisensory dining experiences: experiences that are as much about theatrical performance, entertainment and, increasingly, interaction as they are about the delivery of nutritious and filling food to the hungry and soon-to-be rather poorer diner (Berghaus 2001). In addition, as far as we can tell, technology is also going to be an ubiquitous feature of our fine (and possibly also home) dining in the years to come.

“They work on extracting the essence of the ingredient, and they play with the sense and textures,” Remolina says. “All the senses are involved. Now food is a show.” (Park 2013 interviewing Remolina)

Of course, not everyone is convinced by the turn that so many top-end dining experiences are taking (e.g. Gill 2007; Poole 2012). And that’s fine too (to be expected, even; see the earlier quote from Revel). As we hope to show in the pages that follow, even if you plan never to set foot in a modernist

⁶ What is more, Hervé This – one of the scientists credited with coining the term ‘molecular gastronomy’ – has already pronounced the movement dead (see Ashley 2013)! For This (2012), the future is all about note-by-note cuisine, which he defines as: “a culinary trend in which no plant (vegetables, fruits) or animal (meat, fish) tissues are used, because these traditional food ingredients are mixtures of compounds giving poor control to the cook. Instead, note-by-note cuisine makes use of “pure” compounds in order to build all aspects of dishes: taste, odor, color, texture, and so on.” (This 2012, p. 243). Sounds tasty? You can read more about this new approach to cuisine in Chapter 11.

⁷ As Visser (1991, p. 124) presciently notes, when it comes to cuisine the contemporary taste for novelty offers “a wonderful marketing milieu”.

restaurant, there are still insights to be gained from studying the food that is being served in such venues nowadays – insights that can be applied no matter your favourite food or style of cuisine. Even the slowest of slow food (see Petrini 2007) still has to be served somewhere, and will most likely be eaten with the aid of some sort of cutlery. It is crucial to remember, then, that the atmosphere affects what we think about the food no matter where we happen to be or what we happen to be eating (slow food or modernist cuisine). The same applies when we start to think about the cutlery, the company and even the naming of the dishes that we order. The key point to note here is that while our growing understanding of the new sciences of the table may well be best advanced by looking at what is being served at the top modernist restaurants, the insights that will be uncovered there can hopefully be applied wherever we happen to eat and no matter what we happen to be eating.

1.2.4 On the rise of the celebrity chef

While nouvelle cuisine and molecular gastronomy have swept the world stage, another profound change in the balance of power within the restaurant sector has also taken place. Traditionally, all of the activity in a fancy restaurant would revolve around the front of house. Just think back to the time when the omnipotent restaurateur would meet and greet his guests by name as they arrived, wielding the power to decide who would get to sit at the best tables (Steinberger 2010). Meanwhile, the anonymous chef would normally keep a low profile out back doing exactly as he or she was told. In fact, should the chef in one of these restaurants change, the diner might well not know about it; even if they did, they likely wouldn't care too much. However, the last couple of decades have seen a fundamental shift of power from the front of house to the back (which is no longer always to be found out back).

The rise of the glass-screened kitchen, which has become such a signature feature of so many restaurants nowadays, can be seen as an architectural acknowledgement of this transition. For those who have had the opportunity to dine there, think of the glass-screened kitchen that forms the centrepiece of Heston Blumenthal's Dinner restaurant in the Mandarin Oriental Hotel in London. There is simply no way that the diner can get to their table without catching an eyeful of the action taking place in the kitchen (including all of those pineapples slowly spit-roasting). It is certainly hard to imagine that there has ever been a time previously when anyone would have thought it worthwhile to beam the action live from the kitchen direct to the diners' table (as Daniel Facen now does in his Italian restaurant; see Schira 2011). And never before has the celebrity chef been guaranteed to pack out stadium after stadium (as happened to Heston Blumenthal during his recent tour of Australia) while talking about and demonstrating the latest culinary creations from their kitchens.

1.3 The search for novelty and surprise

Before taking a look at the relevant science underlying the field of gastro-physics, it is perhaps worth dwelling for a moment on the search for novelty that is such a signature feature of so much of contemporary cuisine (and that includes, obviously, *nouvelle cuisine* but also modernist cuisine). This search very often seems as if it were a recent phenomenon. However, Beaugé (2012) makes the case that diners have actually been interested in all that is new for well over a century now. As proof, just take the following: “*It is an exceedingly common mania among people of inordinate wealth to exact incessantly new or so-called new dishes ... Novelty! It is the prevailing cry; it is imperiously demanded by everyone. ... What feats of ingenuity have we not been forced to perform, at times, in order to meet our customer's wishes? Personally, I have ceased counting the nights spent in the attempt to discover new combinations.*” While this might well sound like something that came from the keyboard of one of today's overworked celebrity chefs, the words were actually penned more than a century ago by Auguste Escoffier, head cook of the Paris Ritz and London Savoy (Escoffier 1907, p. vii).

The key point, then, is that we shouldn't think of the search for novelty as being a late twentieth century phenomenon. The desire, at least at the top end of cuisine, has been with us for a very long time. That said, an argument can be made that there probably hasn't been a time previously when the appetite for anything and everything new was quite as strong as it is today, nor found across such a broad section of the dining public. But where exactly does this overriding search for novelty, for the unusual, for the surprising and for the latest ‘new thing’ come from? According to Baumann (1996, pp. 116–121), contemporary dining can be seen in terms of the post-modern ‘consuming body’: the modernist diner as the receiver of sensations. In fact, in his book *Life in Fragments*, Baumann stresses how we currently live in a period of uncertainty: we live in a world where we are unsure if what we are getting is really the best of all possible sensations. The problem for the diner, then, is that it simply isn't possible to measure those sensations and experiences objectively in order to know whether or not they really are the very best.⁸

“Novel or strange edibles are no longer scorned but prized, dinner-party fare is judged according to its surprise value.” (MacClancy 1992, p. 209)

This uncertainty, then, leads the diner – and the modernist chef preparing the food for that diner – to search for the new products and improved food

⁸ Peter Barham, professor of physics and active molecular gastronomist at the University of Bristol, and a number of his esteemed scientific colleagues have gone so far as to suggest that it may, in fact, soon be possible to “*give some quantitative measure of just how delicious a particular dish will be to a particular individual*” (Barham *et al.* 2010, p. 2361). We have to say that we don't yet share their optimism in this regard (but see Savage 2012).

experiences that just might live up to the promise of delivering heightened sensory pleasures at the table (Baumann, 1996, pp. 116–117, as cited in Sutton, 2001, pp. 117–119).⁹ Notice here how novelty comes in many forms: from sourcing the most unusual and/or exotic of ingredients or outré vegetables from the very furthest corners of the globe (MacClancy 1992; Baumann 1996, p. 121; Sutton 2001; Bourdain 2002); from presenting familiar ingredients and flavours in formats that are entirely unfamiliar (see Chapter 7); or from the introduction of unusual new elements into the dining experience, be it technology at the dining table (Chapter 10), dining-in-the-dark (Chapter 8) or the addition of elements of theatre or magic to the gastronomic proceedings (Chapter 11). We believe that the delivery of novel culinary experiences that diners find both satisfying and multisensorially stimulating is increasingly going to be facilitated by our rapidly growing knowledge about how the diner's brain integrates the various sensory and conceptual elements in a dish, by understanding that taste and flavour resides in the mind (and not the mouth) and, of course, by taking this science to the table. As Gill (2007, p. 119) notes “... *taste is something that happens in your head and not, as you might imagine, on your tongue.*” Marion Halligan (1990, p. 209) makes a similar point: “*Chefs, whose livelihood is others' eating, know that the best food begins in the mind*” ... to which we would like to add that that is where the best food experiences end up as well!

At the same time, however, it is worth remembering that the search for novelty can have some unexpected consequences. Although we may be willing to try anything once (Abrahams 1984, p. 23), as least if we happen to be a neophile (Rozin 1999), much of contemporary cuisine cannot really be described as comfort food (Rayner 2008, p. 193; Stuckey 2012, p. 65). What is undoubtedly also the case is that culinary surprise never tastes as sweet the second time around. In fact, we may find ourselves in the bizarre position of having a truly wonderful meal at the hands of a modernist chef (who knows, perhaps even *the* perfect meal), while at the same time having absolutely no desire to want to repeat the experience ever again (cf. Stuckey 2012, on this theme). Take the following from a recent review of the London eatery Restaurant Story:

“Still, Sellers is a serious talent, and his achievement in launching a restaurant this fine at the age of 26 is worth celebrating. Like a good book, Restaurant Story left me feeling stimulated, satisfied and wanting to tell my friends about it. It also left me with a suspicion that, much as I'd enjoyed it, I would probably never need to return.” (MacLeod 2013)

⁹ The search for novelty is “*not merely the treatment of the consumptive experience as an end-in-itself but the search for ever more novel and varied consumptive experiences as an end-in-itself. It is the desire to desire, the wanting to want which is its hallmark*” (Baumann 1996).

1.3.1 The taste of expectation

Expectations are a key point when talking about novelty and surprise. It has been demonstrated that, generally speaking, we tend to like food and drink more if they meet our expectations than if they do not (see Peterson and Ross 1972; Pinson 1986; Lee *et al.* 2006; but see also Garber *et al.* 2000). Whenever we eat and drink in fact, even before we have taken the first mouthful, our brains will have made a prediction about the likely taste/flavour of that which we are about to ingest (Small 2012). They will also have made a judgment call about how much we are going to like the experience (this is known as hedonic expectancy; Cardello and Sawyer 1992; Woods *et al.* 2011). Note also that the appearance sets up expectations regarding the likely satiating properties of a food too, which can also impact on a diner's subsequent feelings of satiety (Brunstrom and Wilkinson 2007; Brunstrom *et al.* 2010).

“A great deal of the pleasure of food is expectation.” (Gill 2011, p. 13)

Food scientists have demonstrated that when a food or beverage item fails to meet our expectations we are likely to evaluate it, both immediately and for a long time thereafter, more negatively than if our expectations had been met (e.g. Cardello 1994; Deliza and MacFie 1996; Schifferstein 2001; Raudenbush *et al.* 2002; Deliza *et al.* 2003; Zellner *et al.* 2004; Yeomans *et al.* 2008). It turns out that we may be especially sensitive to disconfirmed expectation when it comes to our experience of food and drink, since these are the stimuli that we actually take into our mouths (Koza *et al.* 2005). As such, we need to take special care to avoid the risk of poisoning (see Chapter 7). Such findings are once again of fundamental importance to the modernist chef who may well be thinking about deliberately confounding his or her diners' expectations. Take the following example to illustrate the point: when Heston Blumenthal and his colleagues served a savoury ice-cream that looked like sweet strawberry to unsuspecting diners in the setting of the laboratory, those who hadn't been forewarned that it might be salty rather than sweet liked the dish far less both at the time and when tested several weeks thereafter than those who had been told (by the name of the dish) to expect a savoury flavour. In fact, simply giving the dish the name 'Food 386' helped to prepare diners for surprise, to expect the unexpected and so keep their mind open to new experiences. Just how many great-tasting dishes have been spoiled, one wonders, by the failure to get the name of the dish right (see Chapter 3 on the wonderful world of food naming).

“I watched the Blonde get her first course, a neat timbale of salmon hash, beet-cured salmon and sweet dill dressing (what's beet-cured salmon, please?). Her pretty face was a picture of serene expectation. Then, a moment later, it was as if she were [sic] sitting still, but her head were [sic] travelling at Mach three.

She let out a small, strangled mew and coughed: ‘Cat food.’ What, it’s like cat food? ‘No, it is cat food. It’s Rory Bremner beethinied salmon doing such a good impression of cat food, it’s uncanny’.” (Gill 2007, p. 108)

Of course, any self-respecting modernist chef wouldn’t climb very far up the international San Pellegrino rankings if they were to listen to advice such as ‘We really do think that you shouldn’t surprise your diners! Laboratory-based research unequivocally suggests that people just don’t like it.’ This is one of the key areas where the results of laboratory research differ from what happens in many Michelin-starred restaurants. Now, when it comes to surprising the diner (which often involves trying to disconfirm or confound their expectations), this is something that the modernist chef excels at (in a positive way). Indeed, to be surprised is something that many diners have now come to expect when dining at one of the modernist temples to haute cuisine (Rayner 2008). However, our enjoyment of surprise, especially when it comes to food and drink – that is, the stuff that goes into our mouths and that we may swallow and which, as was just mentioned, has the potential to poison us – is going to be very much context dependent.

While surprise can undoubtedly be a very enjoyable and exciting experience if the diner knows that they are safe in the hands of one of the growing number of culinary artists who has specifically designed the experience to be ‘just so’, it can be far less pleasant when dining at a friend’s house or if you find yourself taking part in a culinary experiment in the context of the research laboratory. Understanding the role of expectations in our dining experiences is therefore going to be absolutely crucial to approaching the perfect meal, as we will see in Chapter 7.

“Standing in Ferran Adrià’s kitchen at elBulli, it is easy to believe that you have slipped down the rabbit hole. Adrià, who would have been the caterer of choice for the Mad Hatter, invents food that provokes all the senses, including the sense of disbelief. His success is almost as amazing as his food.” (Lubow 2003)

1.3.2 Food as theatre: the multisensory experience economy meets cuisine

In the pages that follow, we are going to see how the new art of the table is increasingly as much about the theatre of the overall experience as it is about the taste of the food on the plate (in a way, building on Pine and Gilmore’s 1998, 1999 influential work on ‘the experience economy’; see also Kotler 1974; Hanefors and Mossberg 2003). At this point in history and for the foreseeable future, should we be lucky enough to stumble across it or search it out (as one of the growing number of food tourists; Boniface 2003; Hall *et al.* 2003; Rayner 2008), the perfect meal will likely involve some combination of

great (and probably novel) culinary sensations together with a healthy dose of theatre/story-telling in what will be a truly immersive multisensory dining experience (Blumenthal 2013).

“It is food as theatre.” (Elizabeth Carter, Good Food Guide editor, cited in BBC News story ‘Fat Duck wins award despite scare’)

1.4 The brain on flavour

At this stage in the proceedings, it should be clear that the perfect meal involves so much more than merely how the food on the plate tastes. As such, it suddenly becomes clear that we need to draw on a whole new range of scientific disciplines/insights in order to really understand what is going on in the diner’s mind in response to the all-new multisensory experiences that they find themselves exposed to.

Now, it isn’t strictly true to say that scientists have *not* been studying the experience of flavour; they have. More often than not however, this study is carried out in a very basic way typically at the behest of one of the large food or drink companies (Meiselman 2013). The results that emerge from such research may well have been of interest to the company who wants to know how to reduce the salt in their breakfast cereal without the consumer detecting it (Stuckey 2012), or else answering a company’s queries about exactly how much fish meal you can feed a chicken before the average supermarket consumer will taste it in the breast meat.¹⁰ However, while such research is undoubtedly worthy, it fails to address many of the most pressing questions about how to deliver the most stimulating and memorable multisensory dining experiences with which we are concerned in this book. We are fortunate here that our understanding of how the brain experiences flavour have benefited greatly from the recent emergence of a new field of research that goes by the name of ‘neurogastronomy’.

1.4.1 Neurogastronomy

Neurogastronomy – the study of the complex brain processes that give rise to the flavours that we all experience when eating or drinking – really emerged as a scientific discipline in the first years of the twenty-first century. The term itself was first coined by Gordon Shepherd, a distinguished professor at Yale School of Medicine (Shepherd 2006, 2012). We certainly believe that a number of the studies that have investigated which parts of the brain light up when

¹⁰ This isn’t the kind of tasting panel that you want to get stuck on for a year, although we have friends who have been (and they were scarred by the experience, never being able to look at a chicken breast in quite the same way ever again). Note that things can get a whole lot worse; see Pickering (2008) if you don’t believe us!

a participant, lying in the brain scanner, is fed something or other (often some liquid or purified foodstuff delivered by means of a tube inserted into their mouth) have generated some fascinating results (e.g. St-Onge *et al.* 2005). Neuroimaging studies have, for example, enabled researchers to understand why exactly it is that people think that a drink tastes better when they have been told that it costs more (Plassman *et al.* 2008; Spence 2010). They have also highlighted the way in which different brands of soft drink (e.g. Coke vs Pepsi) can end up recruiting different brain networks (McClure *et al.* 2004; see also Kühn and Gallinat 2013).

Neuroimaging has also been used to investigate whether wine experts use more of their brain when tasting than the rest of us do; the answer, it turns out, depends on which study you read (Castriota-Scanderbeg *et al.* 2005; Pazart *et al.* 2011). Furthermore, surprising though it may seem, more of our brain lights up when we merely think about (or anticipate) food than when we actually get to taste it (O'Doherty *et al.* 2002; see also Pelchat *et al.* 2004).¹¹ Researchers have even started to delve into the question of which parts of the brain become more active when we decide whether or not we would like to taste a particular novel combination of ingredients (i.e. something that we have never eaten or come across before; Van der Laan *et al.* 2011; Barron *et al.* 2013). For example, do you think that you would like the taste of a raspberry and avocado smoothie? Or how about a green tea jelly, or beet-root custard? Only future research will tell whether today's modernist chefs exhibit increased neural activation in areas such as the medial prefrontal cortex (mPFC) that have been shown to light up when we perform such a task, given all the practice they have undoubtedly had in terms of imagining weird and wonderful combinations of ingredients with which to assault their diners' senses (Maguire *et al.* 2000).

It turns out that food really is one of the most effective stimuli in terms of modulating brain activity. This is especially true if we happen to be hungry. For example, in one neuroimaging study, a 24% increase in whole brain metabolism was observed when a group of hungry participants were shown, and allowed to smell, their favourite foods (e.g. a bacon, egg, cheese sandwich or cinnamon buns; see Wang *et al.* 2004). This is a massive change in brain activity in what is by far the body's most blood-thirsty organ (e.g. Wrangham 2010; Allen 2012), especially when compared to the 1–2% signal changes that are typically reported in the literature.¹²

¹¹ This presumably explains why, when offered a great meal at a fancy French restaurant, people typically choose to delay the pleasure of actually consuming it (Loewenstein and Prelec 1993). Gilbert (2006, p. 17) summarizes the underlying premise here: “*Forestalling pleasure is an inventive technique for getting double the juice from half the fruit.*” Seen in this light, the interminable waiting list for a table at many of the world's top restaurants could actually work to enhance the diner's experience when they eventually get to eat there.

¹² According to Allen (2012, pp. 51–52), “*The human brain accounts for only 2% of the body's mass, but a whopping 20–25% of the body's resting metabolic rate.*”

“... on a day-to-day basis, from the moment we are born until the moment we die, there is nothing that concerns us more than food.” (Allen 2012, p. 180)

At this point, we can only speculate as to whether there might be a link between the profound neural and physiological changes that can be triggered when a person looks at (and/or smells) an appetizing plate of food and the recent growth of gastroporn.¹³ Indeed, the growing importance of the visual appearance of food, a trend that as we have seen already was really promoted by the emergence of the *nouvelle cuisine* movement, seems to make perfect sense once it is realized that ‘eye appeal’ really is half the meal (or as Apicius, the first century Roman gourmet is purported to have said: “*The first taste is always with the eyes*”).¹⁴ Given just how important the sight of food is, we are clearly going to need to learn as much as we can about the visual aesthetics of plating (see Chapter 4).

In fact, one of the most fascinating examples of the way in which our brain controls our food behaviours actually comes not from neuroimaging research but rather from neuropsychology (that is, from the study of patients suffering from brain damage). Take the bizarre case of those patients afflicted by *Gourmand Syndrome* (Regard and Landis 1997; Steingarten 2002). This is a rare neurological condition in which a stroke (one that typically affects the insula) results in an individual suddenly acquiring a profound and all-consuming interest in fine food! This can sometimes happen to those who previously expressed no interest in food whatsoever (i.e. those would eat to live rather than vice versa). Seemingly overnight, these patients develop an overriding passion for fine gastronomic cuisine. Such curious examples left Jeffrey Steingarten (2002), the famous North American food critic, to ponder: “*With nearly every bite I take, in the back of my mind there looms the same nagging question: Who is having all the fun? Is it my brain or is it really me?*”

1.4.2 Do neurogastronomists make great-tasting food?

Given the importance of the brain to multisensory flavour perception, one question that would likely spring to mind here is whether you are likely to have your perfect meal while sitting in a restaurant serviced by a chef practicing neurogastronomy. This is no longer a purely hypothetical question. For while he may not have come up with the term, the credit for first combining culinary science with brain science should probably go to Miguel Sánchez Romera, a friend of Ferran Adrià. For a while, Sánchez Romera combined two careers, one as a neurologist by day and the other as a

¹³ As Allen (2012, p. 74) notes, there certainly needs to be some account of why there are now so many more cookbooks out there than anyone could ever manage to cook from over an entire lifetime.

¹⁴ Although given how much our brains appear to like looking at appetizing foods, it is somewhat surprising that most Western diners dislike the idea of menus that contain full-colour pictures of the dishes being served (see Chapter 2).

practicing chef by night. Somehow, he even found time to write the intriguing book *La Cocina de los Sentidos* in which he combines his two passions (Sánchez Romera 2003). He eventually closed his Spanish restaurant situated close to Barcelona, L'Esguard de Sant Andreu de Llavaneres, and moved to New York City's Chelsea district to open another one named Romera (McLaughlin 2011). Miraculously, it looks like the restaurant has managed to survive the excoriating review it received from Frank Bruni in *The New York Times* (Bruni 2011).

"Its chef, Miguel Sánchez Romera, is a doctor who worked for years as a neurologist. He has coined a whole new genre for his cooking, which favors squishy textures, kaleidoscopic mosaics of vegetable powders, and a wedding's worth of edible flowers. He calls it neurogastronomy, which 'embodies a holistic approach to food by means of a thoughtful study of the organoleptic properties of each ingredient,' or so says the restaurant's Web site. Organoleptic means 'perceived by a sense organ'. I looked it up." (Frank Bruni on Romero, one of the world's first neurogastronomy restaurants in Chelsea, New York City; Bruni 2011)

Of course, it is unlikely that the neurogastronomy movement will lose momentum simply because of the activities of any one of its practitioners (or because of a negative review, no matter how bad it might be). We would, however, argue that this example helps to illustrate the more fundamental point that neurogastronomy – understanding the brain on flavour – provides insights about only a small part of what makes a wonderful meal truly great. It should always be remembered that sticking people into the noisy claustrophobic coffin that is the contemporary functional magnetic resonance imaging (fMRI) brain scanner is a most unnatural activity. And when it comes to the study of flavour, things rapidly get much worse (see Spence 2012a). To get a sense of the gulf that separates neurogastronomy research from the real world of dining experiences that we are trying to understand in this book, just imagine yourself lying with your head clamped absolutely still. You have a tube inserted into your mouth pumping in who knows what liquid or puréed concoction as you lie flat on your back.¹⁵ Worse still, each squirt of real flavour is typically washed down with a gob of artificial saliva. (OK, that may not be what the scientists conducting these studies call it, but that is essentially what it is – the most neutral of mouth washes!)

Can such research really provide useful insights about the organization of the flavour perceptual system in the human brain? Absolutely! Just see Small (2012) for a summary of the current state of the art in this regard. That said, it is important not to lose sight of the fact that the situation of the isolated participant being scanned in a noisy neuroimaging machine in a science faculty

¹⁵ In the near future, the introduction of vertical bore scanners (that will allow the participant to sit upright while the scanning apparatus is lowered over their head) will allow for more naturalistic consumption behaviours while brain images are acquired.

is very far removed from the social interaction of eating a great meal in a wonderful location surrounded by your close friends (see Chapter 2). As in so many other areas, one needs to be cautious about the ‘neuromania’ (the term coined by Legrenzi and Umiltà 2011) that has swept the cognitive neurosciences (and many other fields of research) in recent years.¹⁶

As the results reviewed above have shown, research in the field of neurogastroonomy is really starting to help researchers understand a little more about the fundamentally important role of food in the organization and responsiveness of the human brain. However, while knowing more about how the brain processes flavour is one thing; understanding the key factors contributing to the perfect meal is quite another. With that clearly in mind, let us then move on to look at the other new sciences of the table that will make their appearance in the pages ahead.

1.5 Food and the perception of everything else

How much of our pleasure in savouring a great meal resides in the quality, freshness and seasonality of the ingredients and how they have been prepared, and how much depends on ‘the everything else’, that is, the tablecloths, the feel of the cutlery, the name of the dish and the atmosphere and ambiance? This is a debate that we have had with a number of chefs. Every one of us, whether a chef, a diner or even a food critic, likes to think that we can taste the quality of the food. That is, we all (and this includes experimental psychologists and budding gastrophysicists alike) believe that we can evaluate the merits of a food or dish and ignore the ‘everything else’. However, a very large body of empirical evidence suggests that this is simply an illusion: a convincing one, granted, but an illusion nonetheless. In fact, the field of experimental psychology research is filled with exposing just such misperceptions that permeate so many aspects of our daily lives (e.g. Chabris and Simons 2011; Kahneman 2011). Certainly, when the scientists investigate what happens to people’s ratings of food and drink when they change the colour of the plate, the ambient lighting, the music, the cutlery, etc., they often find that those ratings change significantly. This is not only true for the sensory-discriminative qualities of what a diner happens to be eating (e.g. what it tastes of and how intense the flavour is), but also for their hedonic responses (i.e. how much do they like the experience). But when you ask people do you think that the colour of the plate or the weight of the cutlery had any influence on your experience of the dish, we all say “*Of course not. Are you crazy?*”

¹⁶ It sometimes seems like everyone wants to stick the ‘neuro-’ prefix in front of whatever discipline it is they happen to be interested in, giving it an air of scientific respectability that simply may not be warranted (see also Tallis 2008; Poole 2012, pp. 71–72; Spence 2012a). One needs to be especially cautious here given McCabe and Castel’s (2008) claim that people are more likely to be convinced by an argument if it is accompanied by a colourful brain image; the more colourful the picture, the more convincing the argument appears to be (but see also Michael *et al.* 2013 for the latest take on an ever-changing story).

“How much of our enjoyment of a great meal originates in the food and drink itself and how much comes from the ‘everything else’?” is a question that we are frequently asked by journalists hungry for a figure or better still a percentage to put in their columns. Now the serious scientist is loath to provide such a number; it obviously depends on so many different factors (and whatever number you give, you will undoubtedly be criticized by your academic colleagues for having simplified matters too much or for having failed to consider some or other factor or issue). Nevertheless, when you combine all of the evidence outlined in the pages that follow, it’s hard not to come away from the research convinced that a ‘good half’ of our experience of food and drink is determined by the ‘everything else’. We are going to come across a lot of research showing how pretty much every conceivable factor can make a difference to the way in which we perceive, respond to and remember food (and drink).

Of course, the food itself is absolutely critical. No one can argue with the claim that sourcing the best, the freshest and the most flavourful ingredients and having the culinary skills to allow those components to show their full potential and to harmonize them with whatever else happens to be on the plate is going to be a necessary precondition for the perfect meal. However, if that wonderful food is served up at 35,000 ft in an airplane or in a grotty work canteen, it simply will not taste the same. The profound impact of the atmospherics of the environments in which we choose to eat and drink on our dining experience will be covered in Chapter 9.

We can’t deny that the claim that so much of the experience of a great meal depends on the ‘everything else’ comes as anathema to many of the chefs we work with. In fact, we have known some of them to get more than a little agitated when we start to talk to them about how important the ‘everything else’ really is. Many chefs, especially those of a more traditional persuasion, will tell you that great food is nothing more than simply the freshest, tastiest of ingredients, skilfully prepared and beautifully presented. For many of them, there really is nothing else. Very often however, these are the very same chefs who have their restaurant situated in a converted knitting museum or who are happy to let the duty manager make the musical selection by blasting every diner in the restaurant with their own personal iPod selection. Others that we have spoken to start muttering something like *“You mean that you can serve dog food, and people will like it if you just play the right music?”*¹⁷, the blood rushing to their faces. We honestly believe that that is unlikely to be the case (Chossat and Gergaud 2003). What we are really much more interested in is making sure that wonderful food is really shown at its best.

¹⁷ We are reminded of the infamous dog food study (Bohannon *et al.* 2009). A group of researchers in the US invited people over to taste a range of pâtés, one of which was actually made from blended dog food (top quality, of course). Remarkably, the participants were unable to pick out the pet food from the other four store-bought pâtés. But before you decide to save a little money next time you invite your friends round for dinner, it should be noted that the blended dog food didn’t score particularly well in terms of liking.

1.6 Gastrophysics: the new science of the table

We have hopefully convinced you by now that understanding the perfect meal requires us to know about much more than merely the preparation and presentation of the food on the plate and more than just which parts of the brain light up. The question then becomes one of which other sciences are going to be relevant in developing a further understanding of what is really driving the diner's experience. Another important question that emerges, and one that we hope we'll find an answer to, is: "Why do you love foods that I hate?" (Lauden 2001). Why is there seemingly just as much chance of finding people who love the new concepts of dining as there is of finding people who detest them?

In the pages that follow, you will be hearing a lot more about 'gastrophysics', a term that first appeared in a 2005 article in *New Scientist* magazine. The year 2012 saw the first international symposium devoted specifically to the topic of 'The Emerging Science of Gastrophysics'. This ground-breaking meeting was held at the Royal Danish Academy of Sciences and Letters in Copenhagen (see Mouritsen and Risbo 2013). By now, the meaning of the 'gastro-' part of this term should be clear. The 'physics' in the title, meanwhile, we take to refer to the science of psychophysics. This is a field of research in which scientists investigate the way in which people (formerly subjects, although we now prefer to call them participants; but whatever you call them, they are mostly still WEIRD¹⁸) respond to sensory stimuli; essentially treating the human as if they were a physical detector that responds in a highly predictable manner to a given set of parameterized sensory inputs (Gregory 1987).¹⁹ Gastrophysics isn't a culinary movement as such. Rather, it is simply the name given to a range of tools, techniques and ways of thinking about the diner's response by means of assessing the impact of various factors – that are both internal and external to the food and drink itself – on the multisensory dining experience.²⁰

So what are the tools, techniques and approaches that lie at the heart of the new discipline of gastrophysics? We believe that well-controlled experiments, conducted both in the laboratory and out there in the real world, are absolutely central to this nascent field of research: experiments that involve the rigorous measurement of the diner's experience using carefully designed questionnaires, response scales and behavioural tests (some of them involving implicit measures). As psychologists, we are highly reticent about putting

¹⁸ That is, Western, Educated, Intelligent, Rich (relatively speaking) and Democratic (see Henrich *et al.* 2010).

¹⁹ The curious thing is that few traditional psychophysicists, not to mention experimental psychologists, have seemingly ever wanted to get their hands dirty messing around in the world of taste and flavour.

²⁰ Some of the other terms that people have come up with over the years include "gastrophy", as suggested by the nineteenth century French Utopian socialist Charles Fourier (Ferguson 2004, p. 100; Cowen 2012, p. 13), and "gustemology", a set of "approaches that organize their understanding of a wide spectrum of cultural issues around taste and other sensory aspects of food" (Sutton 2010, p. 215). Neither of these terms has caught on however, so we'll stick with gastrophysics here.

too much weight on the unconstrained self-report of participants. Why? Time and again research has shown that relying on such reports can often paint a misleading picture concerning the critical factors that are actually driving perception and behaviour (Martin 2013; see also North *et al.* 1997 for a particularly nice example of this dissociation).

It is important to note that many of the laboratory studies in this area can be criticized for their lack of ecological validity. Indeed, one important limitation associated with trying to interpret the results of many studies that have been published to date is that the scientists concerned have typically tended to eliminate all of the extraneous variables in order to focus on just one (or at most a couple) of factor(s) that are of particular interest to them. As such, a participant may find him- or herself sitting alone in a dark science lab²¹ with no background noise (or perhaps some white noise playing over headphones), nor any other distractions, focusing their attention squarely (or so the experimenter hopes) on the task at hand. Rating the sourness of 20 samples of yoghurt on a 7-point sweetness scale, for example, would not be an unusual test.

A second problem that one should be aware of when interpreting the results of food research that has been conducted in the science lab is that, in the majority of cases, the scientists running the studies will typically have utilized what is known as a within-participants experimental design. What this means in practice is that each participant is exposed to each and every one of the conditions of interest (often several times in quick succession). This kind of experimental design is favoured because it enables the researchers to rule out any differences between participants as the cause of any effects that they observe; these differences could hinder the interpretation of a between-participants experimental design. In this case, we can never really be sure whether the participants in each group were really matched in all possible regards. However, one unintended consequence of the between-participants experimental design is that it can serve to emphasize any differences between the various conditions in a manner that is rather unnatural.

As a consequence of such limitations, the gold standard in terms of ecological validity is when the scientist is able to test his/her hypotheses in an actual restaurant (or cafeteria) setting. However, the challenge for the budding gastrophysicist is that it can be very difficult to find a restaurateur who is willing to have his/her venue taken over in the name of science. (And those who do allow it may not want the results to be made public). Using such realistic settings to conduct behavioural experiments can however be criticized for lack of control over a number of other key variables that might be expected to impact on a person's responses. For instance, consider the fact that the diners are eating at different speeds while chatting among themselves; they potentially may

²¹ The walls of all the best psychophysics labs are painted with matt black paint. This helps to avoid any unwanted reflections.

be distracted from the food and the experimental variables of interest (e.g. Meiselman 1992; Köster 2003).

In the pages that follow, we are ideally looking for those factors that contribute to delivering the perfect (or at least enhanced) meal that have been backed up by the results of both types of research, that is, where the weaknesses of laboratory studies are made up for by the strengths of the real-world tests and vice versa (see also de Graaf *et al.* 2005). At present however, having such converging evidence is a rare luxury. What is more, the results of these different types of study can sometimes actually deliver different conclusions (e.g. see Chapter 5 for an example when psychologists investigated the effects of changing the size of the plate on people's consumption behaviours). When this happens, it is obviously going to be that much more difficult to know quite what conclusion to draw. Perhaps the best that one can say is that more research is needed, and leave it at that.²²

One final issue to bear in mind here is that, as yet, there is a real paucity of long-term follow-up studies. While many of the studies reviewed in this book provide relatively convincing evidence concerning the short-term consequences of this or that intervention – whether it be changing the colour of the plates, the weight of the cutlery, or the name of the dish, etc. – what we really need to see much more of in the years to come are longer-term follow-up studies investigating whether a given intervention continues to influence people's performance over weeks, months and possibly even years after it has first been introduced.

That said, and despite these various limitations, it is very exciting to see how many of the current generation of young chefs are interested in going beyond the basic culinary science that they have been taught in cookery schools such as the Institut Paul Bocuse and the Cordon Bleu in order to learn more about the key insights from gastrophysics (and even computational gastronomy; see Ahn *et al.* 2011) that are most relevant to delivering great-tasting food experiences. Many of these chefs are really curious to learn more about the minds, and not just the palates, of their diners. Increasingly, we also see chefs at all levels of fame and fortune working with designers to create custom menus, plateware, cutlery and dining spaces.²³ These chefs are creating experiences that build on all that contemporary design and technology has to offer paired with the latest findings from the field of gastrophysics.

“We’re quite close to throwing out the theory of five tastes,” [Heston] says. ‘Researchers have found 21 receptors for bitterness on the tongue. There is a growing argument that fat is a taste.’ All of this will change the way chefs flavour their dishes.” (Heston Blumenthal being interviewed by Jay Rayner 2006)

²² Note that a number of scientific journals no longer allow their authors to make such statements. But are there any areas of science where such a claim doesn't apply?

²³ In fact, the last few years have seen an exciting shift from straight sensory science to a more integrated approach to culinary arts and meal science (Gustafsson 2004).

A growing number of chefs, spearheaded by the likes of Heston Blumenthal and Andoni Aduriz in San Sebastian, are now spending time visiting the psychology, physiology and/or neuroscience labs in order to gain whatever scientific insights they can to enable them to deliver differentiated culinary experiences to their diners. In some cases, diners may never have had such experiences before.²⁴ Many chefs are now increasingly coming to realize that what they put on the plate is only a part of the diner's overall experience. We have all had the experience: we all know that food and drink taste different depending on where we happen to be eating or drinking (see Chapter 9), not to mention with whom (see Chapter 2).²⁵ The challenge is therefore how to bring the science of the diner together with the rapidly evolving science of the kitchen into an all-new culinary experience that can really blow a diner's mind.²⁶ There is also a growing interest here in taking the diner on some kind of emotional journey.

1.7 Food perception is fundamentally multisensory

What is particularly exciting at the present time is that we currently know far more about the principles of multisensory integration giving rise to flavour perception than ever before (Stevenson 2009; Dijksterhuis 2012; Spence 2012c, 2013). What is more, a number of the world's top chefs have started to wake up to the importance of stimulating all the senses to deliver multisensory dining experiences that are more engaging, more exciting and ultimately more memorable than ever before. Just take the following quotes:

"Eating is the only thing we do that involves all the senses. I don't think that we realize just how much influence the senses actually have on the way that we process information from mouth to brain." (Heston Blumenthal, Tasting menu from 2004, The Fat Duck restaurant, Bray, UK)

"Cooking is the most multisensual art. I try to stimulate all the senses." (Ferran Adrià, elBulli, quoted in Anonymous 2007, p. 19)

Delivering great-tasting food is about more than merely stimulating each of the diner's senses individually (Dornenburg and Page 1996). Rather, it is

²⁴ Unfortunately, while many chefs and culinary teams are generally interested in the new sciences of the kitchen, they rarely have the funds to support such research.

²⁵ This phenomenon has started to be studied under the evocative title of the Provencal Rose Paradox.

²⁶ Note that many of the top restaurants actually lose money, and lots of it. But this isn't always as problematic as it sounds because very often the flagship restaurants act as the loss-leaders for the chef's brand, whether selling cookbooks or salad dressing, TV shows or stadium-filling tours (see Gill 2011).

a matter of knowing how one sense affects another. Chefs will likely benefit from learning a little more about the latest in scientific discoveries as they relate to the world of cuisine. For example, once you come to understand that many scientists believe that around 80–95% of what you think of as flavour actually comes from your nose (Martin 2004; Rosenblum 2010; Ge 2012), you might start thinking rather differently about the aromatic element of your dishes. Furthermore, the chef's ability to deliver great-tasting food can't be harmed by the knowledge that there may be as many as 20 different basic tastes according to some researchers, not just the 4–5 that most people can name (sweet, sour, bitter, salty and umami; Stuckey 2012). We'd also hope that chefs would want to find out more about how changing the aroma of a food (by adding the aroma of strawberry or vanilla, say) can change its perceived sweetness, and how changing the colour of a food or beverage can send a very powerful signal to the diner's brain about the likely taste and flavour that they are about to experience. Every food producer would benefit from knowing how to make the food and drink taste 10% sweeter without the addition of any extra calories or artificial sweeteners (Spence *et al.* 2010). Over the last decade or so, neuroscientists have started to uncover a number of the key rules that are used by the diner's brain (in fact, used by every one of our brains) to combine the information from the tongue with that from the nose, eyes and ears: rules such as superadditivity, subadditivity and sensory dominance. In Chapter 6 we'll take a closer look at the latest evidence concerning the multisensory perception of flavour and the rules governing how all of our brains combine the evidence from each of their senses.

“But the biggest development will be in what [Heston] calls ‘sensory design’. No longer will eating out be just about putting stuff in our mouths and deciding whether it’s nice. ‘Eating is a multisensory experience.’” (Heston Blumenthal being interviewed by Jay Rayner in 2006)

1.8 Isn't modernist cuisine only for the lucky few?

Journalists sometimes question what we do: *“Isn't it the case,”* they ask, *“that what you do is all very esoteric. Something that only a moneyed minority can ever enjoy? Surely, there is nothing in all of this that has any relevance whatsoever to the everyday person preparing a meal for their friends at home, say?”* We would counter such a question by pointing to the fact that the modernist restaurant provides the perfect verve for new culinary ideas coming from the field of gastrophysics. What happens in the top-end restaurant provides the ideal test-bed for culinary innovation. In fact, the overarching idea behind much of our own research is that the best of what starts in the modernist restaurant will eventually feed down to the high street and home dining environment.

The top modernist chefs can be thought of as equivalent to the F1 drivers of the motor racing world. Just think of the many millions that are spent on technological innovations directed at saving the Lewis Hamiltons of this world one-hundredth of a second on the Grand Prix circuit. It is hard to justify such expense in itself, but the fact is a number of the most successful of the innovations that start out in such cars will sooner or later find their way into the cars coming off the production line. It may take 5 years or even longer, but sooner or later it will happen and that is a key part of what makes the whole endeavour worthwhile. We believe that exactly the same is true for the top modernist chefs. Indeed, a number of the ideas that could only ever have been trialled in a modernist restaurant (or perhaps in a Futurist dinner party; see Poole 2012) are now starting to percolate down to society at large. Some of the latest techniques and inventions that high-end chefs have been perfecting over the last decade or so have now become standard practice in the catering industry. The modernist restaurant can therefore be seen as a veritable hotbed for gastro-nomic invention, and hence the ideal venue in which to study gastrophysics. Take for instance the technique of *sous-vide* cooking that has been popularized and developed by chefs such as Heston Blumenthal and Thomas Keller. This technique is likely to become increasingly popular across the commercial restaurant sector for the cost saving (relative to other cooking techniques) it offers, if not for the differentiated flavour experience and enhanced flavour retention that this technique can provide.

For those with an eye on the marketplace, one can also see that certain modernist dishes that were once available only at the world's most exclusive tables (foods like the mustard ice cream served at Heston Blumenthal's The Fat Duck) are now being served more and more in down-to-earth venues²⁷ or found on supermarket shelves or kitchen stores. In fact, a growing number of the world's most famous practising molecular gastronomists are now teaming up with supermarket chains or else selling their own product lines direct to market. For example, think of all those spherification (or molecular gastronomy) kits that are available to chefs (e.g. <http://www.albertyferranadria.com>) or celebrity chef's ranges of food (<http://www.telegraph.co.uk/foodanddrink/foodanddrinknews/7873046/Heston-Blumenthal-launches-range-of-food-at-Waitrose.html>). The modernist or molecular approach can also be seen making its way into other sectors. For instance, the molecular mixologists are increasingly following ever more closely on the heels of the molecular gastronomists (e.g. Sherman 2008; http://en.wikipedia.org/wiki/Molecular_mixology; <http://www.thecocktailovers.com/tag/professor-charles-spence/>), and they aren't the only ones. Visit one of the modernist ice cream parlours (Schlack 2011, <http://www.humphryslocombe.com>) and even modernist fish

²⁷ Of course, whether one thinks this is a good thing is a very different matter (see Chapter 8 for some of the pitfalls of applying modernist principles in the home setting). We don't know about you, but we are certainly starting to tire of seeing 'the triple-cooked chip' appearing on menus in restaurants and gastropubs across the globe.

and chips (take a walk down Upper Street in Islington, North London if you don't believe us).

In line with the idea of broadening the reach of modernist cuisine, a number of the molecular gastronomy chefs have now attempted to open restaurants that are more affordable to the general population. This is not to say that all of the wonderfully wacky culinary ideas that have been tried and tested in the confines of the modernist restaurant will necessarily work outside in the wider world of cuisine, as we'll see in the last chapter. While popping candy has certainly helped to enliven the menu at The Fat Duck, this proved to be just a step too far when Heston Blumenthal added a shake of this noisy food additive to the food on the menu at the UK's Little Chef chain of motorway pit stops (Fleming 2013).

So will the latest discoveries from the emerging field of gastrophysics only benefit the culinary elite? Absolutely not. For us, the challenge in this area is to take a number of the top insights gleaned from studying what goes on at some of the world's top restaurants and translate them so that they can be utilized by diners at every table. We are firmly of the belief that many of the insights and discoveries reported in this book (a number of which have come from the modernist restaurant) are actually things that any one of us can utilize at home in order to improve our everyday dining experiences.

If food really does seem to be of higher quality when eaten with the aid of heavy cutlery (Piqueras-Fiszman and Spence 2011), if desserts really do taste sweeter when served on round white plates (Piqueras-Fiszman *et al.* 2012), if playing Italian opera really can make your pizza and pasta sauce taste more authentically Mediterranean (see Spence 2012 for a review) and if we all eat less if served from smaller bowls onto smaller plates with the aid of smaller cutlery (or, better still, chopsticks for the unacquainted; Wansink 2006), the implications are right there for each and every one of us to incorporate into our daily routines. For one very simple trick here, just try holding the bowl that you eat from in your hands, rather than letting it rest on the table, assuming it is suitably heavy (and the heavier the better in this regard). The weight in your hand will likely make you feel more satiated with however much food you eat (Piqueras-Fiszman and Spence 2012).²⁸ The hope is that the insights discussed in the chapters that follow can be used as the basis for delivering culinary experiences and guidelines that can make everyone's life better.²⁹

²⁸ It has been estimated that in the UK 30% of the money spent on food is on that which we eat away from home (Binkley *et al.* 2000).

²⁹ The economist Cowen (2012, pp. 2–3) makes a similar point at the beginning of his recent behavioural economics book *An Economist gets Lunch*. There he notes that understanding where the quality of the experience lies has huge implications, not just for the world of fine dining; it may also constitute an important step towards feeding the world's 7 billion people – a grand and worthy aim we're sure you will agree. However, we must confess that do not see quite how or why? The 'percolating down' argument unfortunately does not mean that those suffering from food shortages in Africa will necessarily be fed.

Last, but by no means least, is the fundamental question of whether our search for the basic science underpinning the perfect meal can help to combat the global obesity crisis (e.g. Caballero 2007). We, along with many others, are certain that one part of the solution here will have to come from our growing understanding of the neuroscience and behavioural economics of flavour (Lau *et al.* 1995). We passionately believe that gastrophysics has its part to play here; it can provide the evidence to back up the guidelines and practical suggestions concerning the subtle nudges (Thaler and Sunstein 2008) that might help to move people towards healthier eating behaviours (Marteau *et al.* 2012). Each and every one of these strategies should not only help those with nutritional issues to eat more healthily, but also to feel more rewarded (and hopefully satiated) after the meal.

“A bad or mediocre meal is more than just an unpleasant taste; it is an unnecessary negation of life’s pleasures. It is a wasted chance to refine our tastes, learn about the world, and share a rewarding experience.” (Cowen 2012, p. 11)

In fact, the happiness experts tell us that blowing our hard-earned cash on experiences such as a great meal is the most rewarding path to happiness (Dunn and Norton 2013). However, the pleasure may soon diminish after any more than one or two delicious meals as Jay Rayner (British food critic and broadcaster) discovered; his wonderful book recounting his 7-day sojourn to a number of the world’s top French Michelin-starred restaurants describes just how quickly the pleasure of fine dining can wear off (Rayner 2008).³⁰

1.9 Amuse bouche

So, hearing your stomach start to rumble, we would like to end this chapter by serving you a few *amuse bouche* concerning some of the insights that you are going to come across in this study of the perfect meal. First, let us tell you that nothing will be left to chance, from the mood you’re in when your first course arrives³¹ to the position on the menu of that oh-so-tempting starter (or *hors d’oeuvre* if you will), to how much thinner your wallet is going to be when you eventually leave (Chapter 2). After reading this book, you will hopefully understand a little more about why it is that most people are willing to pay twice as much for an ‘*Omelette à la Norvégienne*’ than for a ‘Baked Alaska’, being one and the same dessert. You will also learn why some people may end

³⁰ One can think of this as the gastronomic equivalent of Morgan Spurlock’s heroic attempt to eat nothing but McDonalds for a month, as portrayed in the memorable 2004 documentary *Super Size Me*.

³¹ As we’ll see in the next chapter, the waiters at The Fat Duck carefully watch their diners to know whether they are left or right handed. If you are a leftie, when you sit down after a visit to the bathroom the cutlery will have been reset to match your personal proclivities. Nothing said; an absolutely seamless performance.

up feeling a little nostalgic while eating a ‘Grandma’s chicken pie’ dish from the work canteen (Chapter 3).

In addition, and as a palate cleanser, we are going to see how the visual appearance of a dish can be just as important as its flavour and that, on occasion, the canvas will turn out to be just as important as the painting itself (Chapter 4). The canvas, or in this context where and how the food is presented to the diner sitting at the table, can play all manner of tricks on you to the extent of modulating how much you eat and how much you (or your brain) thinks that you enjoyed the experience afterwards. We will be serving up some of the dishes that will help you to understand what we mean here; we might even make you salivate in the process.

What about the cutlery? Bigger, smaller, textured or smooth, warm even (no, really)? The everyday utensils that we instinctively grab for when dining have evolved and modelled the ways in which we interact with food; as we will see later, they may even have changed the shape of our jaws (Chapter 5). Once the table has been cleared away, we bet that you will not be able to believe the many creative new ways in which cutlery (or its absence) is being utilized by the world’s top chefs today. During the *intermezzo* of our feast, you’ll be served a shot of cognitive neuroscience so that you will know a little more about how your brain integrates all the sensory information that it receives while your stomach is filling up, from eye and ear to nose and mouth (Chapter 6). (We hope to have served this somewhat complex material in a format that you will find at least reasonably easy to digest!) You’ll then taste some sensorially incongruent dishes, a perfect means of achieving and hopefully delighting the exigent diners; the only essential prerequisite to enjoy it is that you are something of a neophile when it comes to food (Chapter 7).

For dessert, we’ll be walking you through the experience of dining in the dark (Chapter 8). You will soon discover just how important vision is in terms of perceiving what it is that we are eating; perhaps this will help to explain why this isn’t everyone’s cup of tea. On the other hand, we will also be highlighting a number of other alternative approaches including those who have chosen to play with the lighting, the music and all the other atmospheric elements that are capable of immersing the diner in a truly engaging multisensory experience (Chapter 9).

As a *digestif*, we’ll be serving up the latest trends in digital technology and showing how it is being brought to the table (or at least to the dining room) by the most adventurous of modernist chefs (Chapter 10). We promise to show you some of the ways in which the latest technologies are currently being developed to enhance our eating experiences as you prepare for your dessert. At the end of the perfect meal we hope that you still have a little space left to hear about some of the amazing predictions regarding the future of food, based on what’s happening in the top restaurants today (Chapter 11). Without wanting to advance any particular agenda, we simply hope to enthuse the

open-minded reader about some of the fabulous possibilities lying just around the corner. Ultimately, we hope to share a little of our passion and excitement for these food experiences.

In the pages that follow we hope to convince you that gastrophysics, the new science of the table, really does hold the potential to enhance everyone's dining experience; the results of the research in this area can bring each and every one of us a little closer to that perfect meal. As you will see, achieving that goal is going to require us to bring together the evidence that is now emerging from a diverse range of research fields including experimental psychology, design, neuroscience, sensory marketing, behavioural economics and the culinary and sensory sciences.

And with that, let us wish you “*Bon appétit!*”

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