

The Perfect Meal

The multisensory science of
food and dining

Charles Spence & Betina Piqueras-Fiszman

Foreword by Heston Blumenthal



WILEY Blackwell

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“This book offers insights into all the wonderful sensory elements that make up our memories of a dining experience. For the last two decades the culinary world has been obsessed with modernist cooking and the role science can play in the kitchen. Nowadays more and more chefs are realising that science also has a place at the table; that a dining experience is made up of far more than just good food and that by understanding how we use our senses to interact with and appreciate food we may be able to further enhance our guest's dining experience. This book looks at many topics which will become increasingly relevant to both chefs and society as a whole in the coming years.”

Jozef Youseff, chef and author of *Molecular Gastronomy at Home* (www.kitchen-theory.com)

“Whether your idea of a good night is the local café or the latest Michelin-starred restaurant, it is unlikely that you'll be unaware of the cultural phenomenon that restaurant food has become in recent years. The secrets of chefs—amateur and celebrity—have been laid bare in myriad weighty books and glossy TV programmes. *The Perfect Meal* goes beyond the exotic ingredients and creative insights of the chef and into the realm of the diner's psychology. Using an accessible writing style that neither talks down to the reader nor dumbs down the science, the authors take us into the relatively unexplored world of the dining context: the gastrophysics of the visual, acoustic, tactile—not to mention taste and smell—influences that we are exposed to in every dining experience. This is a new approach to thinking about dining that will appeal to and inform anyone who has ever been convinced to buy a cookbook by its illustrations or who persists, despite failure, in trying to make a reservation at The Fat Duck.”

John Prescott, Ph.D, author of *Taste Matters: Why We Eat the Foods We Do*

“In striving for a hypothetical level of delicious perfection we are forced to look beyond culinary technique and ingredients. Focussing on the brain's interpretation of our eating experience, pioneers Spence and Piqueras-Fiszman acknowledge the interdisciplinary nature of gastronomy, rendering a complex area of study both digestible and applicable.

This valuable input furthers the development of co-evolving disciplines; the scientific study of our brains, and the relentless creativity, experimentation and intuition so important in producing a truly great meal.”

Ben Reade, Gastronome and Head of Culinary Research and Development at Nordic Food Lab

“Not many people are as ready to realise the importance of the senses, not only in cooking but in eating, as Charles Spence and Betina Piqueras-Fiszman. ‘The senses as the starting point for creating’ was one of the most important creative methods of elBulli and one of the pillars of our cooking.

This book demonstrates beyond doubt that gastronomy is the most complex creative discipline that exists. Therefore, I invite you to enjoy the secrets of the fascinating world of the senses from Charles' and Betina's hand, something which is fundamental to enjoy gastronomy.”

Ferran Adrià, elBullifoundation

The Perfect Meal

The Multisensory Science of Food and Dining

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Foreword

The day I fell down the enchanting rabbit hole into the magical wonderland of the senses and began exploring their influence on our culinary likes and dislikes, I encountered a great deal of scepticism and resistance from chefs, diners, and food writers alike. In their eyes, the only thing of real importance was the food on the plate. The idea that the senses might influence our perception of flavour and help generate the pleasure and emotion that can accompany a meal was dismissed by some as nonsense, that reduced cooking and eating to mathematical formulae devoid of emotion. How wrong they were!

Although I only realised it later, my interest in the interplay of the senses and their influence on cuisine must stem from the event that originally made me want to be a chef when I was just 16 years old: a meal on the terrace of a three-star Michelin restaurant in Provence where the smell of the lavender bushes, the sound of the cicadas and the visual splendour of the setting almost seemed to eclipse the food and sent me down the rabbit hole. However, I date my conscious realisation of the culinary importance of the senses to 1997, when I created a dish that featured a crab-flavoured ice cream. The notion of a crab ice cream put some people off because ice cream is sweet, right? This association prevented them from enjoying a savoury version. However, I discovered that if I simply changed the name from 'crab ice cream' to 'frozen crab bisque', most people totally got it- even though it was the same ice cream! The idea that the actual name of a dish could change its whole context and enjoyment was, for me, a total eye opener. (As mentioned in the pages that follow, this dish was the inspiration for a paper from Sussex

University on how the name of a dish can even change its perceived saltiness)

From then on, I researched whatever I could find on the incredible complexity of multisensory flavour perception, and began developing dishes that drew on what I was discovering. At the start of 2004, I unveiled my multisensory approach to cooking at one of the world's foremost gastronomic congresses in a presentation entitled 'Eating is a multisensory experience', and the rest, as they say, is history.

I first met Charles back in 2002 through a mutual friend and mentor of mine, Professor Tony Blake. I still have vivid memories of my first visit to his Crossmodal Research Laboratory in Oxford. He showed me the fascinating Sonic Chips experiment described in Chapter 6, and the idea that sound could radically affect our perception and enjoyment of food started my mind racing, like a kid in a sweet shop. I returned to Bray, got hold of a sound box, and started trying things out for myself.

Since then, Charles and I have worked together on a number of sonic experiments. For one of them we fed test-participants (actually members of the audience at the Art and the Senses conference held in Oxford in 2006) a scoop of bacon and egg ice cream. One group of participants ate the ice cream while listening to the sounds of bacon sizzling in the pan. The others tasted the ice cream while listening to the sounds of chickens clucking in the farmyard. In each case the sound appeared to intensify the relevant flavour. In another experiment, we fed participants oysters while listening either to the sound of the sea (think waves crashing gently on the beach), or to the sounds of farmyard animals, after which we asked them to rate how pleasant the oysters tasted. (Listening to the sound of the sea resulted in people rating the oyster as tasting

significantly more enjoyable, but no more salty when compared to the farmyard soundtrack. Such results giving further support to the notion that sound can indeed influence our emotional response to food.) It was this last experiment (the results you'll find described within the pages that follow) that inspired what is now a classic on the menu at The Fat Duck, "Sound of the Sea", in which seafood, seaweed and edible "sand" are used to create what looks like the edge of the seashore, all of which is accompanied by an iPod and earphones so that the diner can hear the sounds of the waves lapping up against the shore while eating.

There are all sorts of other sensory questions that Charles and I have explored over the years, like whether listening to a low-pitched sound while eating a bitter, crunchy caramel would emphasize bitterness and whether listening to a sharp sound while tasting an acidulated toffee sauce would accentuate its acidity. We even investigated whether listening to a synaesthetically soft sound could enhance the richer, sweeter notes of the sauce. We've used jellies and *pâtes de fruit* in which the colour misleads you into expecting, say, a particular fruit when it is in fact a vegetable (i.e., blackcurrant that is in reality beetroot; lime that is fennel and pumpkin that tastes like apricot... adding fruit acids can flip the mind's interpretation of the colour of a food to blackcurrant) in order to probe the ways in which the senses can nudge us to a different place in terms of our perception of flavour. The senses of sight and taste have nudged the vegetable to a fruit of the same colour, leaving the smell saying little about the matter. And we've pursued ideas based on the early research from Köhler on sound symbolism in which people were shown a pair of two-dimensional shapes, a spiky one and an amoeba-like one, and asked which of the two was a "kiki" and which a "bouba". Despite both names being meaningless nonsense

words, there was an overwhelming conviction that bouba was the rounded amoeba shape and kiki the pointed one. We tried this out with various foods and discovered that a similar correspondence between flavour and sound seemed to exist: for example, milk chocolate – even when brittle from a stint in the fridge – was generally considered more “bouba”, while dark chocolate, even in the form of a light and airy mousse, was overwhelmingly “kiki”.

As will by now be apparent, Charles has been one of my biggest inspirations. He is one of the world's leading researchers in the field of multisensory perception and together with Betina they have opened up new ways of experiencing food by focusing on everything that surrounds it. So it's very exciting that they have turned their groundbreaking fundamental research into a book so that you, too, can be inspired in much the same way that I have been – and still am. The pages that follow will open your eyes to new worlds and new ideas. Charles and Betina are the perfect guides for such a journey given their wide-ranging curiosity, great clarity of thought, and lively minds that are forever spotting connections that illuminate how the world of food and drink really works. If you're at all interested in food and the effect it has on our bodies and, more significantly, on our minds, then *The Perfect Meal* can't fail to entertain, inform and ultimately to dazzle.

Heston Blumenthal
The Fat Duck

Preface

Why is it that what you like I detest? How can it be that what we touch affects what we taste? Can people be nudged towards healthier food choices simply by incorporating a few psychological illusions and neuroscience insights into their cuisine? These are just a few of the intriguing questions that we address in the pages that follow. This book aims to provide the reader with the facts and figures needed to grasp what is it that makes them perceive and experience the food (one of life's greatest pleasures!) in the way that they do and how to improve upon it. Each of the chapters covers a number of the key factors that influence the diner's experience. Our interests lay in understanding from the fancy meals nowadays being served in modernist restaurants through to the family meal served in the comfort of our own home. Throughout, we highlight what we see as some of the most intriguing possible future trends when it comes to food and multisensory dining.

Our goal in writing this book has been to bring together and critically evaluate the large body of empirical research that has emerged in recent years documenting the profound effect that each one of our senses has on our perception and enjoyment of food. The focus, though, is not on the neuroscience of flavour, but rather on all of the other (non-food) factors that influence our overall multisensory experience of food. We outline the transition in research practice from the more traditional approaches to the study of flavour perception founded in the field of sensory science through to the emergence of a number of novel methods to understanding the diner's experience based on areas of research as diverse as cognitive and

decisional neuroscience, marketing, design, and psychology. When taken together, these new ways of thinking about people's response to food give rise to a neuroscience-inspired approach to multisensory design. In this book, we describe all this exciting research in an accessible style for the general readership.

In this volume, we use both the latest research as well as relevant historical examples to illustrate how much more there is to the diner's experience than merely what is sitting there on the plate (if indeed there is a plate - nowadays you can't always be too sure). Indeed, there are researchers out there who are convinced that as much as half of the pleasure in a plate of food (or meal) actually comes from the "everything else"! In the pages that follow, we will highlight what we see as the most relevant and exciting findings to have emerged from the latest studies to have been conducted by sensory scientists, psychologists, neuroscientists, oenologists, and even economists, investigating how important each and every element of the meal (focusing especially on those cues that are extrinsic to the food itself) is to the diner's overall experience. This, then, is "*the new science of the table*" that we want to share our own passion for with the reader: A new field of research that is referred to as gastrophysics.

Many of the chefs whom we have had the good fortune to speak to over the years, and this includes a number with Michelin-stars under their belts (or should that be toques), are convinced that the meal is all, and only, about sourcing the right ingredients, preparing them correctly, and how the food is ultimately presented on the plate. Oftentimes, these chefs spend so much time thinking about the food itself that they forget to give adequate consideration to the mise-en-scene, for example, paying no attention to the music that happens to be playing in the background. As we

will see later, such oversights can have a much greater impact on our dining experiences than might be expected.

Who is this book for? It is primarily aimed at all those people out there who are interested in food and the factors that influence our experience of it. That includes those working in the world of food, or writing about it, that is, the chefs, cooks, marketers, large food companies, research scientists, gourmets, and food lovers (or “foodies”), or simply the curious lay reader, who wants to know more about the key drivers underlying our experience of food. This book highlights a number of the most important influences that distinguish the wonderful, perhaps even that once-in-a-lifetime ‘perfect meal’ from the mundane fare of everyday life. We illustrate the central themes with dishes taken from the tables of some of the world's top restaurants. That said, it is our firm belief that many of the insights can easily be adapted to enhance the home dining experience as well.

Health researchers involved in trying to tackle the current global obesity crisis should also find a number of the findings summarized here to be relevant: So, for example, we provide numerous suggestions concerning ways in which the diner's mind can be tricked into thinking that more food has been consumed than is actually the case. We will also highlight a number of most innovative methods for making food taste sweeter which don't rely on adding a grain of sugar to our pudding. How? The tips here include everything from changing the colour of the plate to adding a little digital seasoning in the form of some sweet-sounding music. This book also contains a number of actionable insights for those working with the aging and hospital populations, where profound nutritional problems abound and are likely to increase unless we do something about it.

Many wonderfully creative minds have accompanied us on the journey that was writing this book. Our special thanks go to Heston Blumenthal and all of the research team at The Fat Duck in Bray for their ongoing interest and support at the frontiers of scientific and creative cuisine. We would also like to thank the many other chefs and culinary artists that we have had the great good fortune to collaborate or share all manner of outlandish ideas with: So, in no particular order our heartfelt thanks go out to Denis Martin (Restaurant Denis Martin); Ben Reade (Nordic Food Lab); Jozef Youssef (Kitchen Theory); Charles Michel (401B), Caroline Hobkinson (Stirring with Knives); Louise Bloor (Fragrant Supper Club); María José San Román (Monastrell Restaurant); Sriram Aylur (The Quilon Restaurant); Wylie Dufresne (WD~50); Blanch & Shock; Bompas & Parr: the chefs at Casa Mia in Bristol; and the Institut Paul Bocuse. We have also benefited greatly from the support of those working in the food science industry, particular thanks going to Francis McGlone, Tony Blake, Barry Smith, John Prescott, Rupert Ponsonby, Michael Bom Frøst, Line Holler Mielby, Ophelia Deroy; and Susana Fiszman. You have inspired us greatly and this book has been possible thanks to your generosity of spirit and ideas.

We would also like to thank all our contributors for having provided us with their images. They range from professional photographers through science researchers, to designers and architecture agencies and all share a passion and curiosity for food and eating experiences. We are also grateful to all those friends and family who have been kind enough to review some of the material that follows; Barbara and Thierry, thank you so much for going beyond the line of duty. Needless to say, the blame for any remaining inaccuracies lies squarely with us.

So, without further ado, let the meal begin...

Chapter 1

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 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, beavering 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 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 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