Sensory and Consumer Research in Food Product Design and Development

Second Edition

Howard R. Moskowitz, Jacqueline H. Beckley, Anna V. A. Resurreccion

IFT Press

WILEY-BLACKWELL

Sensory and Consumer Research in Food Product Design and Development

Second Edition

Howard R. Moskowitz, PhD
President and Founder, Moskowitz Jacobs Inc., White Plains, New York

Jacqueline H. Beckley, MBA
President and Founder, The Understanding & Insight Group LLC, Denville, New Jersey

Anna V.A. Resurreccion, PhD
Distinguished Research Professor, Department of Food Science and Technology, The University of Georgia, Griffin, Georgia

IFT Press

WILEY-BLACKWELL
A John Wiley & Sons, Ltd., Publication

Blackwell Publishing was acquired by John Wiley & Sons in February 2007. Blackwell's publishing program has been merged with Wiley's global Scientific, Technical and Medical business to form Wiley-Blackwell.

Editorial offices: 2121 State Avenue, Ames, Iowa 50014-8300, USA
The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK
9600 Garsington Road, Oxford, OX4 2DQ, UK

For details of our global editorial offices, for customer services and for information about how to apply for permission to reuse the copyright material in this book please see our website at www.wiley.com/wiley-blackwell.

Library of Congress Cataloging-in-Publication Data
Moskowitz, Howard R.
Sensory and consumer research in food product design and development / Howard R. Moskowitz, Jacqueline H. Beckley, and Anna V.A. Resurreccion. – 2nd ed.
p. cm. – (Institute of food technologists series)
Includes bibliographical references and index.
ISBN 978-0-8138-1366-0 (hard cover : alk. paper) 1. Food–Sensory evaluation. 2. Commercial products–Testing. I. Beckley, Jacqueline H. II. Resurreccion, Anna V. A. III. Title.
TX546.M68 2012
664′.07–dc23
2011035804

A catalogue record for this book is available from the British Library.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

Set in 10/12 pt Times by Aptara® Inc., New Delhi, India
Printed and bound in Malaysia by Vivar Printing Sdn Bhd

1 2012

Sensory and Consumer Research in Food Product Design and Development

The *IFT Press* series reflects the mission of the Institute of Food Technologists—to advance the science of food contributing to healthier people everywhere. Developed in partnership with Wiley-Blackwell, *IFT Press* books serve as leading-edge handbooks for industrial application and reference and as essential texts for academic programs. Crafted through rigorous peer review and meticulous research, *IFT Press* publications represent the latest, most significant resources available to food scientists and related agriculture professionals worldwide. Founded in 1939, the Institute of Food Technologists is a nonprofit scientific society with 22,000 individual members working in food science, food technology, and related professions in industry, academia, and government. IFT serves as a conduit for multidisciplinary science thought leadership, championing the use of sound science across the food value chain through knowledge sharing, education, and advocacy.

A John Wiley & Sons, Ltd., Publication

Titles in the *IFT Press* series

- *Accelerating New Food Product Design and Development* (Jacqueline H. Beckley, Elizabeth J. Topp, M. Michele Foley, J.C. Huang, and Witoon Prinyawiwatkul)
- *Advances in Dairy Ingredients* (Geoffrey W. Smithers and Mary Ann Augustin)
- *Bioactive Proteins and Peptides as Functional Foods and Nutraceuticals* (Yoshinori Mine, Eunice Li-Chan, and Bo Jiang)
- *Biofilms in the Food Environment* (Hans P. Blaschek, Hua H. Wang, and Meredith E. Agle)
- *Calorimetry in Food Processing: Analysis and Design of Food Systems* (Gönül Kaletunç)
- *Coffee: Emerging Health Effects and Disease Prevention* (YiFang Chu)
- *Food Carbohydrate Chemistry* (Ronald E. Wrolstad)
- *Food Irradiation Research and Technology* (Christopher H. Sommers and Xuetong Fan)
- *High Pressure Processing of Foods* (Christopher J. Doona and Florence E. Feeherry)
- *Hydrocolloids in Food Processing* (Thomas R. Laaman)
- *Improving Import Food Safety* (Wayne C. Ellefson, Lorna Zach, and Darryl Sullivan)
- *Innovative Food Processing Technologies: Advances in Multiphysics Simulation* (Kai Knoerzer, Pablo Juliano, Peter Roupas, and Cornelis Versteeg)
- *Microbial Safety of Fresh Produce* (Xuetong Fan, Brendan A. Niemira, Christopher J. Doona, Florence E. Feeherry, and Robert B. Gravani)
- *Microbiology and Technology of Fermented Foods* (Robert W. Hutkins)
- *Multivariate and Probabilistic Analyses of Sensory Science Problems* (Jean-François Meullenet, Rui Xiong, and Christopher J. Findlay)
- *Natural Food Flavors and Colorants* (Mathew Attokaran)
- *Nondestructive Testing of Food Quality* (Joseph Irudayaraj and Christoph Reh)
- *Nondigestible Carbohydrates and Digestive Health* (Teresa M. Paeschke and William R. Aimutis)
- *Nonthermal Processing Technologies for Food* (Howard Q. Zhang, Gustavo V. Barbosa-Cánovas, V.M. Balasubramaniam, C. Patrick Dunne, Daniel F. Farkas, and James T.C. Yuan)
- *Nutraceuticals, Glycemic Health and Type 2 Diabetes* (Vijai K. Pasupuleti and James W. Anderson)
- *Organic Meat Production and Processing* (Steven C. Ricke, Michael G. Johnson, and Corliss A. O'Bryan)
- *Packaging for Nonthermal Processing of Food* (Jung H. Han)
- *Preharvest and Postharvest Food Safety: Contemporary Issues and Future Directions* (Ross C. Beier, Suresh D. Pillai, and Timothy D. Phillips, Editors; Richard L. Ziprin, Associate Editor)
- *Regulation of Functional Foods and Nutraceuticals: A Global Perspective* (Clare M. Hasler)
- *Sensory and Consumer Research in Food Product Design and Development, second edition* (Howard R. Moskowitz, Jacqueline H. Beckley, and Anna V.A. Resurreccion)
- *Sustainability in the Food Industry* (Cheryl J. Baldwin)
- *Thermal Processing of Foods: Control and Automation* (K.P. Sandeep)
- *Water Activity in Foods: Fundamentals and Applications* (Gustavo V. Barbosa-Cánovas, Anthony J. Fontana Jr., Shelly J. Schmidt, and Theodore P. Labuza)
- *Whey Processing, Functionality and Health Benefits* (Charles I. Onwulata and Peter J. Huth)

WILEY-BLACKWELL

A John Wiley & Sons, Ltd., Publication

Preface

How do we begin? All beginnings are hard. They may be sweet, but they are hard. Perhaps a personal memory will help introduce our effort. People questioned Howard and me (Jackie) with polite, and sometimes not so polite, skepticism when we talked about measuring a person's emotions that might be associated with food. This was a decade ago, in 2001, before this book, before all three of us grew a bit wiser by 10 years. The skepticism was not just about food, but about vision to take approaches from the comfortable world of food and drink and move it into new-to-us fields as diverse as charitable giving and retailing. Well, today, as we put the final touches on this second edition, the skepticism has gone away. The ideas of a decade ago, the ideas in the first edition of this book, are showing up in many areas. Whether the field is called neuromarketing or behavioral economics, the ideas in the first edition published in 2006 have become a foundation, anchoring the building efforts of others. Our dear friend and longtime colleague, Dr. Harry Lawless, emeritus professor at Cornell University, humorously called the first edition of this book "an articulation of a type zero error—you need to know what you know and don't know to effectively understand type 1 and 2 errors."

But, of course, there's always more. When we began this work, prodded by Mark Barrett of Wiley, we anticipated that there would be more data in the world or a business than *anyone* could understand. And we were determined to bring new science to our field. Anna joined us, and so we had our solid foundation. From statistics to experimental design, from applications to products and onto ideas, we proceeded to elaborate our vision. We hope that the tools in this book, the visions of what could be, the core fundamentals, and the new applications will power us moving forward. We look forward, to yet another edition, the third one, where the core fundamentals of knowledge mapping, value diagramming, and robust, yet fast, Internet testing will be accepted and used widely, bringing our field of sensory and consumer research to the forefront of the food industry.

Author biographies

Howard R. Moskowitz, PhD, is the president of Moskowitz Jacobs, Inc., founded in 1981. Dr. Moskowitz is an experimental psychologist in the field of psychophysics (the study of perception and its relation to physical stimuli) and inventor of world-class market research technology.

Moskowitz graduated from Harvard University in 1969 with a PhD in experimental psychology. He graduated from Queens College (City University of New York), Phi Beta Kappa, with degrees in mathematics and psychology. He has written/edited 26 books, published over 400 refereed articles and conference proceedings, lectures widely, serves on the editorial boards of major journals, and mentors numerous students worldwide. He was named the 2010 winner of Sigma Xi's prestigious Walter Chubb Award for innovation in research across scientific disciplines, a unique honor showing the value of Mind Genomics™, the new field of knowledge he founded. Simply put, Mind Genomics™ is the "Inductive Science of Everyday Life" with the goal of advancing science and business, knowledge and application.

In 2009, Dr. Moskowitz cofounded iNovum to bring the science of Mind Genomics™ and Addressable Minds™ to world industries. iNovum's goal is to commercialize the award-winning science, to reignite the American Dream, to export that dream around the world, and at the same time to improve the education and life prospects of young people of the next generation.

In his 42-year-long career since receiving his PhD from Harvard University, Dr. Moskowitz's science/commercial/visionary work has won numerous awards. These include the 2001, 2003, 2004, and 2006 ESOMAR awards for his innovation in web-enabled, self-authored conjoint measurement, and for weak signals research in new trends analysis and concept development. Self-authored concept technology brings concept/package design development and innovation into the realm of research, substantially reducing cost, time, and effort for new product and service development. In 2005, he received the Parlin Award from the American Marketing Association, its highest award. In 2006, Dr. Moskowitz was awarded the first Research Innovation Award by the Advertising Research Foundation and was also inducted into the Hall of Fame of New York's Market Research Council.

Among his contributions to market research is his 1975 introduction of psychophysical scaling and product optimization for consumer product development. In the 1980s, his contributions were extended to health and beauty aids. In the 1990s, the concept development approach was introduced to pharmaceutical research. His research/technology developments have led to concept and package optimization (IdeaMap®.Net, MessageMap® for pharma), integrated and accelerated development (DesignLab®), and the globalization and democratization of concept development for small and large companies through an affordable, transaction-oriented approach (IdeaMap®.Net).

Dr. Moskowitz's latest efforts focus on four key areas:

(i) *Mind Genomics™ and Addressable Minds™*: Using experimental design of ideas to understand how people respond to everyday situations and products, to what particular,

granular-level mind-set segment a person belongs for each situation, and then determining the array of life-relevant mind-set segments to which a specific person belongs (sequencing the genome of the person's mind).

(ii) *Rekindling the American Dream through the Institute for Competitive Excellence (ICE) at Queens College, City University of New York*: Promoting experimental design of ideas and products to understand customer requirements for products and services, innovating using such information, and increasing American competitiveness through such systematized knowledge.

(iii) *Experience optimization*: Using experimental design to understand and optimize customer experience.

(iv) *The law and psychophysics*: Using experimental design of messaging for juror selection (with law firms) and for package/shelf/web design (dynamic landing page optimization).

Jacqueline H. Beckley, MBA, is founder and president of The Understanding & Insight Group, Denville, NJ. As a business innovator, Ms. Beckley has developed exacting methods for measuring consumer response better, faster, and more clearly. She has directed the creation of some of the earliest database systems for retrieval and storage of consumer information. These systems continue to be refined to advance new product development processes more quickly and accurately. Pinpoint accuracy in knowing consumer wants and how to apply that knowledge to specific products and services is what sets Ms. Beckley heads above others in the field. The approaches that were discussed in the first edition of this book have proven to lead business people and researchers alike to clarity in the front end of the product development process. It works every time!

She combines extensive scientific training with broad exposure to social sciences and fine arts to craft a strategic approach to product and business development. Its results are pragmatic, flexible, creative, and authentic. Along with traditional methods and web-based resources, this integrated approach has fostered leading products that have defined their business categories.

Clients praise her skillful understanding of complex concepts and her astute ability to translate them into practical applications that can be implemented quickly.

Previously, Beckley held positions within industry and consulting, including director of consumer perception at Nabisco, Inc., vice president for Peryam & Kroll Research, group manager of sensory research and R&D for the Quaker Oats Company, and research scientist for Amoco Chemical Company.

Anna V.A. Resurreccion, PhD, is a distinguished research professor in the Department of Food Science and Technology at The University of Georgia. Her current research interests focus on methods in consumer and sensory evaluation, development of value-added products and functional foods, consumer-based optimization of food formulations and processes, and shelf-life determination; these are the topics on which her 597 scientific and technical publications are based. She has authored 157 peer-reviewed journal articles, seven chapters, and two books on consumer sensory evaluation in product design and development; presented 232 papers published as abstracts or proceedings; and another 208 articles in the field of food science and technology. She was former chair of the product development division of the Institute of Food Technologists (IFT), served as Associate Scientific Editor of the Journal of Food Science, and is currently on the editorial board for the Journal of Sensory Studies, among a number of scholarly journals. Dr. Resurreccion is, clearly, one of the world's

most recognized researchers in the field of consumer and sensory science and food quality evaluation for her exemplary achievements and would certainly rank among the world's top outstanding scientists in sensory and quality evaluation in academia.

Dr. Resurreccion's achievements in international peanut product research in Asia, Europe, Africa, and the United States integrate consumer and sensory science with chemistry and engineering, and has far-reaching effects on the design of food products that prevent blindness and vitamin A deficiency in children and on minimizing health problems due to one of the most potent carcinogens, aflatoxin. Her innovative research on consumer-based optimization of innovative food processes to maximize bioactive components in food has led to major breakthroughs in analytical chemistry of phenolic compounds and antioxidants, and for the peanut industry, a patent ready for licensing by a food company, to deliver substantial health benefits to consumers, in products with high consumer acceptance. Dr. Resurreccion has garnered over $12.4 million as principal or coprincipal investigator on several prestigious competitive research awards from the US Agency for International Development and the National Institute for Food and Agriculture.

Dr. Resurreccion is the recipient of numerous international, national, and regional awards, including the Professional Scientist Award (Southern Region of the Institute of Food Technologists), the Gamma Sigma Delta Senior Faculty Award of Merit (University of Georgia Chapter), the International Award from the University of the Philippines College of Home Economics Alumni Association, and the Outstanding Professional Scientist Award for Food Science and Nutrition from the University of the Philippines Alumni Association. The Institute of Food Technologists (IFT) awarded her the distinction of Fellow of the IFT in 2000, distinguished lecturer for IFT for 3 years (2002–2004), and the prestigious Bor S. Luh International award for her outstanding achievements in the field of food science and technology. Furthermore, she is one of no more than three University of Georgia faculty members to receive two D.W. Brooks Faculty Awards, for Excellence in Research and then for Excellence in International Agriculture. Last year, The University of Georgia awarded her the title of Distinguished Research Professor, the highest recognition awarded by the university to its faculty. Dr. Resurreccion is the consummate research professor and, without question, throughout her entire career has truly exemplified sustained excellence in food science research and education.

Acknowledgments

Howard:
There are many people to thank for this second edition of our book. Most of all, however, I'd like to thank my coauthors, Jacqueline Beckley and Anna Resurreccion. It was the three of us who made this book possible, took the journey, and now we bring you our vision of the future, hopefully your future as well.

But there is, of course, more. There is my beloved wife, Arlene, the driving force who continues to inspire. There are the "boys," now men with families of their own, Daniel and David, who prod me to continue developing, never giving me a chance to rest on my laurels, never permitting me to grow stale.

Linda Ettinger Lieberman, my editorial assistant, keeps it all straight, all the time, even when things seem dauntingly complex.

And, of course, the others, most precious of whom is my colleague and friend of 30 years, Bert Krieger, executive vice president of Moskowitz Jacobs, Inc. It is you, Bert, who made many of these ideas come alive with clients. You've prodded, pushed, developed, and improved on my thoughts, in the office and of course at our now-cherished weekly breakfasts.

Thank you each of you, those named and unnamed, who have shared the struggle and who made the pain bearable, the joy worthwhile.

Jackie:
This second edition would not have been possible without the assistance of clients and friends in the field of consumer understanding. Additionally, I want to thank John Thomas for his graphics, Leslie Herzog, Jennifer Vahalik, Nancy Nemac, and Nathalie Tadena for their assistance in updating information, and Linda Ettinger Lieberman at Moskowitz Jacobs, Inc. who has made this one sound even better than the first edition!

Anna:
First, I wish to thank my coauthors, Howard Moskowitz and Jackie Beckley, for their vision that made this book possible, their unsurpassed creativity and innovation that have brought forth a new frontier in product design and development, and their dedication to make this new, bigger, and better second edition through to publication.

I acknowledge a number of people who worked behind the scenes, Lotis Francisco, Jocelyn Sales, and Paula Scott; they provided me with invaluable editorial and technical assistance. To Linda Ettinger Lieberman, whose magic got us to the finish line.

I dedicate my role in this book to Rey, the love of my life. Forty-four years ago, he taught me how to write.

Contents

1 Emerging corporate knowledge needs: how and where does sensory fit?

INTRODUCTION

We begin this second edition of our book with history, as we did before. Why? It's simple. The history of the field tells us a lot about how people think, what problems they faced, what methods they developed, what institutions they created, and what they considered to be worthy of studying and doing. History is not, in the words of Henry Ford, "one damned thing after another." Rather, history embeds within it keys to what we do and why we do it. History is of paramount importance in the world of sensory science because knowing how the field developed tells us a lot about why we do what we do.

During the past 30 years, companies have recognized the consumer as the key driver for product success. This recognition has, in turn, generated its own drivers—sensory analysis and marketing research, leading first to a culture promoting the expert and evolving into the systematic acquisition of consumer-relevant information. Styles of management change as well. At one time, it was fashionable to laud the "maverick executive" as a superior being, perhaps the management equivalent of the expert. Over time, we have seen this type of cowboy machismo declining into disrepute. Replacing this maverick decision-making has been an almost slavish adoption of fact-based decisions, and the flight from knowledge-based insight into the "soulless" reportage of facts.

How does corporate decision-making affect a discipline such as sensory analysis, which has only begun to come into its own during the past four decades? If one were to return to business as it was conducted in the 1950s and 1960s, one might discern a glimmer of fact-based decisions among the one or two dozen practitioners of what we now call sensory analysis. These individuals—scattered in corporations, working quietly in universities, executing food acceptance tests for the US military, and a handful of others scattered about in other countries around the world—were founding the field that now provides this type of fact-based guidance for product development and quality assurance. In the early years, many of the practitioners did not even know that they were creating a science that would emerge as critical, exciting, and eminently practical. These pioneers simply did the tests the best they could, attempted to understand how people perceived products, and in the main kept to themselves, hardly aware of how they were to affect the food industry in the years to come. Many of these pioneers were bench chemists and product developers. They just wanted to know what their work products tasted like, smelled like, especially when the work product was a new food.

Sensory and Consumer Research in Food Product Design and Development, Second Edition.
Howard R. Moskowitz, Jacqueline H. Beckley, and Anna V.A. Resurreccion.

As the competition among companies to secure market share in consumer goods relentlessly increased, and as the consumer continued to be bombarded with new products, it became increasingly obvious to many that consumer acceptance would be increasingly paramount. Whereas before one might hear such excusing platitudes as "people always have to eat" as an excuse for complacent mediocrity, one would now hear catch phrases such as "consumer tested" or "significantly preferred." Companies were catching on to the fact that the consumer had to actually like the product. The privations of World War II and before were fading in memory. The supply economy was giving way to the demand economy. The consumer, surfeited with the offerings of countless food manufacturers, could pick and choose among new products that often differed only in flavor or in size from those currently available. In the face of such competition by fellow manufacturers, it became necessary for the marketer and product developer to better understand what consumers would actually buy, and in so doing perhaps understand what consumers really wanted.

The end of the twentieth century saw the professionalization of product testing. What had started out 50 years before as a small endeavor in corporations to "taste test foods" as one step in the quality process became a vast undertaking (e.g., Hinreiner, 1956; Pangborn, 1964). Company after company installed large market research departments reporting to marketing and sensory analysis departments reporting to R&D. Whether this was the optimal structure was unclear. Often, the two departments did similar studies. The express purpose of these often-competing departments was to ascertain what consumers wanted, and feed back this information in a digested, usable form to those who either had to create the product at R&D or those who had to sell the product. The era of fact-based decision-making was in full swing. Decisions would no longer be made on the basis of the response from the president's "significant other" (whether husband, wife, child), but rather would be made on the basis of well-established facts, such as the positive reaction by consumers who would test the product under conditions that management would trumpet as being "controlled and scientific." Such fact-based decision-making would be introduced into all areas dealing with consumers, first as a curiosity, then as a luxury, and finally as a desperate necessity for survival. For the food and beverage industries, the emergence of fact-based decision-making would bring new methods in its wake.

THE ERA OF THE EXPERT, AND THE EMERGENCE OF SENSORY ANALYSIS OUT OF THAT ERA

The real business-relevant beginnings of sensory analysis occurred in the 1950s and 1960s, and can be traced to the quantum leap in business thinking provided by Arthur D. Little Inc. (ADL), in Cambridge, Massachusetts. ADL was a well-known consulting company, with one division specializing in agribusiness. In the 1940s, a group of enterprising consultants at ADL developed the Flavor Profile, a then-revolutionary idea to quantify the flavor characteristics of foods (Cairncross & Sjostrom, 1950; Little, 1958). The Flavor Profile was precedent shattering on at least two fronts:

(i) *Systems thinking*: No one was thinking about flavor in this organized, quantifiable fashion. It was certainly unusual to even think of a formalized representation of flavor. Researchers had thought about flavors for years, but the formalization of a descriptive method was certainly new.

(ii) *Anyone could become an expert—albeit after training*: The expert reigned supreme, in brewing, in perfumery, etc., but to have the experts created out of ordinary consumers by a formalized training program was new thinking.

Sensory analysis as an empirical discipline emerged from the application of expert judgments in formalized evaluation. Before the Flavor Profile (Caul, 1957), the expert judgment would certainly be called upon and relied upon as the last word. The notion of consumer acceptance, or consumer input, was not particularly important, although the successful product would be touted as filling a consumer need. The Flavor Profile formalized the role of the expert in the situation of disciplined evaluation. The expert was given a new task—evaluate the product under scientific conditions. ADL won numerous contracts on the basis of their proclamation that the Flavor Profile could assure so-called *flavor leadership* for a product.

At about the same time as ADL was selling its Flavor Profile, the US Government was winning World War II. The popular aphorism attributed to Napoleon Bonaparte that "an army travels on its stomach" guided the development of new methods. The US Quartermaster Corps recognized the importance of food to soldiers' health and morale. The slowly emerging scientific interest in measuring responses to food, appearing here and there in industry, took strong root in the military. Measuring soldiers' food preferences became important because the commanders could often see firsthand the effects of food rejection. Unlike the executives sitting at the heads of food companies, the commanders walked among their troops. Failure to feed the troops meant a weakened army and the real prospect of a lost battle or even war. Food acceptance became a vital issue, and its measurement a key military task (Meiselman & Schutz, 2003).

The confluence of sensory analysis in the food industry and the military recognition of the importance of consumer-acceptable food produced in its wake the sensory analysis industry. The industry did not emerge overnight. It emerged slowly, haltingly, like all such new creatures do, with false starts hampered by wrong decisions, but in its own way matured. Expert panel approaches begun by ADL matured to more quantitative, statistics-friendly methods such as quality data analysis (QDA) (Stone *et al.*, 1974). Military interest in food acceptance led to advances in sensory testing, and the 9-point hedonic scale (Peryam & Pilgrim, 1957) to actually measure the level of acceptance. The US Government funded research into food acceptance (Meiselman, 1978) and eventually got into the funding of taste and smell psychophysics, especially at the US Army Natick Laboratories where Harry Jacobs built up a cadre of young scientists interested in the sensory evaluation of foods (Meiselman & Schutz, 2003). Other organizations such as the Swedish Institute for Food Preservation Research in Gothenburg (now Swedish Institute for Food Research) pioneered research methods and applications as well as recording the literature from the burgeoning field (Drake & Johannsen, 1969).

Industrial organizations adopted methods for product testing, and the field grew and prospered. The field heralded its maturity through journals and conferences. The first major international symposium involving sensory analysis took almost 50 years from start of the field in the 1940s. This Pangborn Symposium held in Jarvenpaa, Finland, just outside of Helsinki, attracted more than 200 participants. The organizing committee headed by Dr. Hely Tuorila had expected this conference to represent a one-off event, but the palpable excitement shared by the participants soon changed the committee's mind. Eleven years later, the same conference, in its fifth convening, held in Boston, attracted more than 700 participants.

Popularity increased so that from being held every third year the conference is now held every second year. Allied conferences, such as Sensometrics, also developed, to the point where the Sensometrics Conference is held on the years that the Pangborn Symposium is not. The field was well on its way. Scientific decision-making in the food industry had given rise to a new discipline.

The ensuing years would be good to the field of sensory. The Pangborn conferences would be the first specific conferences. They would give impetus to more US-based conferences such as the SSP (Society of Sensory Professionals). Of course, once these meetings began to occur, the floodgates opened. There would be meetings in Europe, Latin America, and Central America. It is always a good thing when meetings proliferate. At some point, they rationalize and the better ones survive, but the first meetings of the various sensory organizations pump the necessary emotional and intellectual nutrients into the field.

The success of the Pangborn Symposia, along with their continuing increase in attendance in the face of decreasing attendance at other conferences, deserves a short digression that can also shed light on the growing field of sensory analysis and the pent-up needs of the members. When the era of the expert was in its heyday, there were no conferences to speak of, and the professionals in sensory analysis were few, scattered, and scarcely aware of each other, all laboring away in, as John Kapsalis had often said, "splendid isolation." The Pangborn Symposium brought these individuals together in a concentrated, 4-day format, somewhat longer than that provided by the more conventional professional organization such as IFT (Institute of Food Technologists). At least six things occur at such extended meetings:

(i) *Masses of people with very similar interests interact in a confined location.* The participants meet with individuals who are, by and large, sympathetic to them. Rather than participating in specialized symposia where the sensory specialists come together, albeit as a minority, in the Pangborn Symposium they come together with many of the same purposes. This mass of people is an intellectual hothouse.

(ii) *Easy meetings occur so that like-minded people can reach out to each other.* The interpersonal nature of the meeting cannot be overemphasized. Many people have known each other for years, so the close and long meeting allows these people to renew acquaintanceship.

(iii) *Density plus time plus fatigue reduce interpersonal barriers.* The surrounding density of people at the meeting and the continued stimulation over time from seeing people with common interests leads to fatigue, real reduction of barriers, and increased professional intimacy.

(iv) *Long meetings create shared memories.* The 4-day period suffices to imprint many positive memories of interactions on the participants. The scientist lives in the future, propped up by memories and propelled by hopes.

(v) *Information intake and exchange allows people to take each other's measure.* The plethora of posters, talks, and meals shared together allows people to come and go at their convenience, spend time looking at other people's work in an unhurried situation and, in general, get comfortable with each other. They size up each other, challenge, share, form opinions of character, of promise, and of expectations for each other's future. In a sense, people learn about each other in a way no journal article could ever hope to imitate.

(vi) *The laying on of hands, from the older to the young, occurs more readily in this environment.* The young researcher can get to meet the older, more accomplished researcher

on a variety of occasions, some professional and some social. This opportunity to meet each other in the field produces in its wake a cadre of inspired young professionals who can receive the necessary reinforcement from their older role models in this artificially created, short-lived "hothouse of kindred souls." One should never underestimate the value of interpersonal contacts in science, and the effect on the morale, motivation, and joy of a younger scientist who is recognized and encouraged by an older role model. The Pangborn Symposium was set up, perhaps inadvertently, but nonetheless successfully, to produce that motivation and "laying on of hands" over its extended, 4-day time.

THE MANIFOLD CONTRIBUTION OF PSYCHOPHYSICS

Psychophysics is the study of the relation between physical stimuli and subjective experience (Stevens, 1975). The oldest subdiscipline of experimental psychology, psychophysics makes a perfectly natural, almost uncannily appropriate, companion to sensory analysis. The study of how we perceive appearances, aroma, tastes, and textures of food might easily be a lifelong topic of psychophysical research. Indeed, many of today's leading sensory analysts have been grounded either in formal education in psychophysics or at least have enjoyed a long-term interest in the details of psychophysics. Psychophysics did not start out as the conjoined twin of sensory analysis, although to many novices in the field the intertwining of the two areas seems unusually tight and quite meaningful.

Psychophysicists are natural complements to sensory analysts, but with a slight change in focus. Sensory analysts study the product, using the person as a bioassay device. Knowledge of how we perceive stimuli does not help sensory analysts do their job better in terms of the specifics, but does give the analyst a broader perspective in which to operate. Psychophysics uses stimuli as probes to understand how the sensory system processes external information. Historically, and for a great many years, psychophysics confined itself to the study of "model systems," such as sugar and water or simple chemical odorants. In their desire to be pure, these psychophysicists valued systematic control over real-world behavioral meaning. Psychophysics of taste and smell followed psychophysics of hearing and vision, wherein the stimulus variability could be controlled by the researcher and then channeled into systematic stimulus variation.

Psychophysics expanded its scope, however, in the early 1970s as a group of young researchers moved out from academia to the applied world. During the 1960s, psychophysics underwent a renaissance, initially promoted by S.S. Stevens at Harvard University but later taken up by others worldwide in a variety of fields. These young researchers found that they could use Stevens' method of magnitude estimation to measure the perceived intensity of stimuli. Stevens had provided the tool, and young researchers, such as Linda Bartoshuk, William Cain, Donald McBurney, Herbert Meiselman, Howard Moskowitz, and others, would use the magnitude estimation method for direct estimation of sensory magnitudes, applying it to model systems first, and then to more behaviorally meaningful stimuli such as foods, beverages, the environment, etc. (e.g., McBurney, 1965). Bartoshuk, Meiselman, and Moskowitz all began their careers with some involvement at the US Army Natick Laboratories, in Massachusetts, working with Harry Jacobs. Natick would stimulate each to look at the application of psychophysics to food problems, a stimulation that would have lifelong consequences for these researchers and for their contributions to the field.