Sensory Evaluation Techniques

Fourth Edition

Morten Meilgaard, D.Sc.
Senior Technical Advisor
The Stroh Brewery Company
Detroit, Michigan

Gail Vance Civille, B.S.
President
Sensory Spectrum, Inc.
New Providence, New Jersey

B. Thomas Carr, M.S.
Principal
Carr Consulting
Wilmette, Illinois

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Preface

How does one plan, execute, complete, analyze, interpret, and report sensory tests? Hopefully, the practices and recommendations in this book cover all of those phases of sensory evaluation. The text is meant as a personal reference volume for food scientists, research and development scientists, cereal chemists, perfumers, and other professionals working in industry, academia, or government who need to conduct good sensory evaluation. The book should also supply useful background to marketing research, advertising, and legal professionals who need to understand the results of sensory evaluation. It could also give a sophisticated general reader the same understanding.

Because the first edition was used as a textbook at the university and professional levels, partly in courses taught by the authors, the second, third, and fourth editions incorporate a growing number of ideas and improvements arising out of questions from students. The objective of the book is now twofold. First, as a "how to" text for professionals, it aims for a clear and concise presentation of practical solutions, accepted methods, and standard practices. Second, as a textbook for courses at the academic level, it aims to provide just enough theoretical background to enable the student to understand which sensory methods are best suited to particular research problems and situations and how tests can best be implemented.

The authors do not intend to devote text and readers' time to resolving controversial issues, but a few had to be tackled. The second edition was the first book to provide an adequate solution to the problem of similarity testing. This was adopted and further developed by ISO TC34/SC12 on Sensory Evaluation, resulting in the current "unified" procedure (Chapter 6, Section II, p. 60) in which the user's choice of α- and β-risks defines whether difference or similarity is tested for. Another first is the unified treatment of all ranking tests with the Friedman statistic in preference to Kramer's tables.

Chapter 11 on the Spectrum™ method of descriptive sensory analysis, developed by Civille, has been expanded. The philosophy behind Spectrum is threefold: (1) the test should be tailored to suit the objective of the study (and not to suit a prescribed format); (2) the choice of terminology and reference standards should make use not only of the senses and imagination of the panelists, but also of the accumulated experience of the sensory profession as recorded in the literature; and (3) a set of calibrated intensity scales is provided that permits different panels at different times and locations to obtain comparable and reproducible profiles. The chapter now contains full descriptive lexicons suitable for descriptive analysis of a number of products, e.g., cheese, mayonnaise, spaghetti sauce, white bread, cookies, and toothpaste. Also new is a set of revised flavor intensity scales for attributes such as crispness, juiciness, and some common aromatics and two training exercises.

The authors wish the book to be cohesive and readable; we have tried to substantiate our directions and organize each section so as to be meaningful. We do not want the book to be a turgid set of tables, lists, and figures. We hope we have provided structure to the methods, reason to the procedures, and coherence to the outcomes. Although our aim is to describe all tests in current use, we want this to be a reference book that can be read for understanding as well as a handbook that can serve to describe all major sensory evaluation practices.

The organization of the chapters and sections is also straightforward. Chapter 1 lists the steps involved in a sensory evaluation project, and Chapter 2 briefly reviews the workings of our senses. In Chapter 3, we list what is required of the equipment, the tasters, and the samples; while in Chapter 4, we have collected a list of those psychological pitfalls that invalidate many otherwise good studies. Chapter 5 discusses how sensory responses can be measured in quantitative terms. In Chapter 6, we describe all the common sensory tests for difference, the Triangle, Duo–trio, etc.; and, in Chapter 7, the various attribute tests, such as ranking and numerical intensity scaling, are discussed. Thresholds and just-noticeable differences are briefly discussed in Chapter 8, followed by what we consider the main chapters: Chapter 9 on selection and training of tasters, Chapters 10 and 11 on descriptive testing, and Chapter 12 on affective tests (consumer tests). All the descriptive references have been reviewed and revised for the Spectrum references in Chapter 11. Chapter 12 defines, in detail, several qualitative and quantitative classic methods for testing with consumers and includes substantial reviews of "fuzzy front end" and internet research techniques.

The body of text on statistical procedures is found in Chapters 13 and 14, but, in addition, each method (Triangle, Duo–trio, etc.) in Chapters 6 and 7 is followed by a number of examples showing how statistics are used in the interpretation of each. Basic concepts for tabular and graphical summaries, hypothesis testing, and the design of sensory panels are presented in Chapter 13. We refrain from detailed discussion of statistical theory, preferring instead to give examples. Chapter 14 discusses multifactor experiments that can be used, for example, to screen for variables that have large effects on a product, to identify variables that interact with each other in how they affect product characteristics, or to identify the combination of variables that maximize some desirable product characteristic such as consumer acceptability. Chapter 14 also contains a discussion of multivariate techniques that can be used to summarize large numbers of responses with fewer, meaningful ones to identify relationships among responses that might otherwise go unnoticed, and to group respondents of samples that exhibit similar patterns of behavior. New in the fourth edition is an overview of Thurstonian Scaling. In addition to studying differences among products, Thurstonian Scaling can be used to uncover the decision processes used by assessors during their evaluations of products. Also new in the fourth edition is a detailed discussion of data-relationship techniques used to link data from diverse sources collected on the same set of samples. The techniques are used to identify relationships, for example, between instrumental and sensory data or between sensory and consumer data. They can reveal the sensory and instrumental characteristics of products that have the greatest impact on acceptance and the intensities of these characteristics that are predicted to be most well liked by consumers.

At the end of the book, the reader will find guidelines for the choice of techniques and for reporting results plus the usual glossaries, indexes, and statistical tables.

With regard to terminology, the terms *assessor*, *judge*, *panelist*, *respondent*, *subject*, and *taster* are used interchangeably as are *he*, *she*, and *(s)he* for the sensory analyst (the sensory professional, the panel leader) and for individual panel members.

Authors

Morten C. Meilgaard, M.Sc., D.Sc., F.I. Brew, is visiting professor (emeritus) of Sensory Science at the Agricultural University of Denmark, and he is senior technical advisor and vice president of research (also emeritus) at the Stroh Brewery Co., Detroit, Michigan. He studied biochemistry and engineering at the Technical University of Denmark where he returned in 1982 to receive a doctorate for a dissertation on beer flavor compounds and their interactions. After 6 years as a chemist at the Carlsberg Breweries, he worked from 1957 to 1967 and again from 1989 as a worldwide consultant on brewing and sensory testing. He served for 6 years as director of research for Cervecería Cuauhtémoc in Monterrey, Mexico, and for 25 years with Stroh. At the Agricultural University of Denmark, his task was to establish sensory science as an academic discipline for research and teaching.

Dr. Meilgaard's professional interests are the biochemical and physiological basis of flavor, and more specifically, the flavor compounds of hops and beer and the methods by which they can be identified, namely, chemical analysis coupled with sensory evaluation techniques. He has published over 70 papers. He is the recipient of the Schwarz Award and the Master Brewers Association Award of Merit for studies of compounds that affect beer flavor. He is the founder and past president of the Hop Research Council of the U.S., and he is the past chairman of the Scientific Advisory Committee of the U.S. Brewers Association. For 14 years, he was chairman of the Subcommittee on Sensory Analysis of the American Society of Brewing Chemists. He has chaired the U.S. delegation to the ISO TC34/SC12 Subcommittee on Sensory Evaluation.

Gail Vance Civille, **B.S.**, is president of Sensory Spectrum, Inc., New Providence, New Jersey, a management consulting firm involved in the field of sensory evaluation of foods, beverages, pharmaceuticals, paper, fabrics, personal care, and other consumer products. Sensory Spectrum provides guidance in the selection, implementation, and analysis of test methods for solving problems in quality control, research, development, production, and marketing. She has trained several flavor and texture descriptive profile panels in her work with industry, universities, and government.

As a course director for the Center for Professional Advancement and Sensory Spectrum, Ms. Civille has conducted several workshops and courses in basic sensory evaluation methods as well as advanced methods and theory. In addition, she has been invited to speak to several professional organizations on different facets of sensory evaluation.

Ms. Civille has published several articles on general sensory methods as well as sophisticated descriptive flavor and texture techniques. A graduate of the College of Mount Saint Vincent, New York, with a B.S. in chemistry, Ms. Civille began her career as a product evaluation analyst with the General Foods Corporation.

B. Thomas Carr, **M.A.**, is principal of Carr Consulting, Wilmette, Illinois, a research consulting firm that provides project management, product evaluation, and statistical support services to the food, beverage, personal care, and home care industries. He has over 18 years of experience in applying statistical techniques to all phases of research on consumer products. Prior to founding Carr Consulting, Mr. Carr held a variety of business and technical positions in the food and food ingredient industries. As director of Contract

Research for NSC Technologies/NutraSweet, he identified and coordinated outside research projects that leveraged the technical capabilities of all the groups within NutraSweet Research and Development, particularly in the areas of product development, analytical services, and sensory evaluation. Prior to that, as manager of Statistical Services at both NutraSweet and Best Foods, Inc., he worked closely with the sensory, analytical, and product development groups on the design and analysis of a full range of research studies in support of product development, QA/QC, and research guidance consumer tests.

Mr. Carr is a member of the U.S. delegation to the ISO TC34/SC12. He is actively involved in the statistical training of scientists and has been an invited speaker to several professional organizations on the topics of statistical methods and statistical consulting in industry. Since 1979, Mr. Carr has supported the development of new food ingredients, consumer food products, and OTC drugs by integrating the statistical and sensory evaluation functions into the mainstream of the product development effort. This has been accomplished through the application of a wide variety of statistical techniques including design of experiments, response surface methodology, mixture designs, sensory/instrumental correlation, and multivariate analysis.

Mr. Carr received his B.A. in mathematics from the University of Dayton and his Master's degree in statistics from Colorado State University.

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Contents