

# Sensory Evaluation Practices



HERBERT STONE  
JOEL L. SIDEL

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# SENSORY EVALUATION PRACTICES

SECOND EDITION

**Herbert Stone**  
**Joel L. Sidel**

Tragon Corporation  
Redwood City, California



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# SENSORY EVALUATION PRACTICES

SECOND EDITION

# FOOD SCIENCE AND TECHNOLOGY

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*To the memory of Rose Marie Pangborn  
who worked with a total commitment to the betterment of  
the science of sensory evaluation*

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# ABOUT THE AUTHORS

In this Second Edition of *Sensory Evaluation Practices*, the authors, Herbert Stone and Joel L. Sidel, draw from their extensive experience to provide readers with the background and understanding necessary to make informed decisions about managing a sensory evaluation program. Particular attention is given in this edition to organizing and structuring resources to better operate in today's competitive business environment.

In 1974, Stone and Sidel founded the Tragon Corporation, an important sensory consulting and testing company offering full-service consumer goods research. As a pioneering company in the field of sensory evaluation, Tragon has been able to offer unparalleled capabilities to its customers through the Quantitative Descriptive Analysis (QDA) sensory method, a market evaluation system developed by Stone and Sidel.

Cumulatively, the authors have over half a century of experience in the field of sensory evaluation. In addition to founding the Tragon Corporation, the authors have conducted domestic and international workshops; designed, analyzed, and reported on over 10,000 sensory tests; and have been sensory consultants to the senior management of most major food and consumer products companies.

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# PREFACE TO THE SECOND EDITION

In the seven years since the publication of the first edition of this book, there have been many changes in the field of sensory evaluation. New books and journals devoted to sensory evaluation have appeared, professional associations have experienced increased membership, and there is a much greater awareness of sensory evaluation academically and in business. More universities are offering courses in sensory evaluation and more companies are recognizing the value of sensory information. This latter change created opportunities for sensory professionals that we have addressed in more detail in this revised edition. Careful consideration also has been given to the reviews of the first edition and the comments provided by numerous individuals who have written to or talked with us about the book.

In this edition we have added more background information about various recommended procedures and practices, particularly with regard to organizing and structuring resources to better operate in today's competitive business environment. Attention also has been given to methodology emphasizing developments in descriptive analysis. Several new methods have been proposed and are now in use leading to more literature on these and related topics.

As was stated in the first edition this book is not intended as a review of the literature. However, some of the literature is discussed in detail as it relates to specific methods and procedures. Attention is also given to the more practical issues of the strategy that sensory professionals use as they communicate information and demonstrate the cost benefits derived from a full-scale sensory program.

Numerous individuals contributed to the ideas expressed here, and to the opportunity to put these ideas into practice. In particular we wish to acknowledge the contributions of Patricia Beaver, Melanie Pons, and Jean Eggert (retired), of Kraft General Foods—USA; and Birgit Lundgren of Kraft General Foods—Europe; Margaret Savoca and Harvey Gordin of R. J. Reynolds Tobacco Company; Katy Word of Coors Brewing Company; and Erik von Sydow of Nestlé.

Our associates also provided helpful comments and, through their questions, enabled us to enhance our perspectives of certain problems. In particular we



wish to acknowledge Brian McDermott, Rebecca Newby, Heather Thomas, Dr. Richard Singleton of SRI International, and Professor Howard Schutz of the University of California at Davis. Finally, we wish to recognize the important contributions of our longtime friend and associate, the late Professor Rose Marie Pangborn of the University of California at Davis who worked tirelessly to educate students encouraging them to pursue a career in sensory evaluation, and worked with a total commitment for the betterment of the science of sensory evaluation. This edition is dedicated to her memory.

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# PREFACE TO THE FIRST EDITION

There has long been a need for guidance in the development and application of sensory evaluation within the corporate environment. The purpose of this book is to provide this guidance and to identify principles and practices that will result in increased utilization of sensory evaluation. In recent years there has been a considerable increase in the number of individuals working in the field who lack the necessary academic training or practical skills for sensory evaluation. Published guides have described test methods and suggested procedures for the analysis of results from sensory tests, but have not provided the rationale behind the selection of a particular procedure or test method. This book addresses this and other equally important gaps in the field, including the organization and operation of a testing program, the design of a test facility, recommended procedures for the selection, screening and qualifying of subjects, and the communication of actionable results. We have drawn heavily from our more than two decades of research and consulting in this field. To our knowledge, no other book provides such an extended coverage of the topic.

With regard to sensory evaluation, this book expounds a particular philosophy that can best be described as one that places greatest emphasis on the concepts of planning and decision analysis in the broadest sense. For the sensory professional, the ability to provide test services should not be considered the primary goal but rather a resource that can be used if a problem warrants it. With each request, the sensory evaluation professional must decide how best to meet the needs of the requestor and what methods to apply to the problem. Considerable emphasis is placed on the quality of the information derived from a test. It is also important to have sufficient behavioral and statistical knowledge to understand the nature of a problem, to ensure that the experimental design is appropriate to the test objective, to understand results, and to communicate them in an actionable way.

The book is organized into three main parts. Chapters 1 and 2 trace the development of the field and define sensory evaluation: What it does, how, where, and for whom. Chapters 3 and 4 address the more fundamental issues of measurement, psychological errors in testing, and statistics and experimental design. Chapters 5, 6, and 7 provide the reader with a detailed description of the three classes of test methods (discrimination, descriptive, affective), criteria used to select a specific method, and suggested procedures for data analysis and the interpretation of

results. A final chapter and epilogue focus on a series of problems that require substantive sensory evaluation involvement: for example, storage testing, measurement of perceived efficacy, correlation of instrumental and sensory data, and systems for product optimization.

To the extent possible, pertinent literature has been referenced and discussed. However, this book is not intended as a review of the literature. In those sections with few references, the authors have drawn on their extensive experience to describe a recommended procedure or practice. For example, there is little or no published information on the design of a test facility, and the authors' experience was used to develop the enclosed diagrams and to assist the sensory professional in this endeavor.

The book is intended for sensory professionals, technical managers, product development and production specialists, and research directors considering the establishment of a program or anticipating expansion of existing resources. Marketing, marketing research, and advertising professionals will also benefit from the information in this book. The increased interaction between the technologist formulating the product and those responsible for marketing the product requires a greater awareness of sensory evaluation by everyone concerned. Individuals considering sensory evaluation as a career will also benefit from reading selected chapters of this book. In particular, Chapters 1, 3, 4, and 8 will provide both an overall perspective and specific examples of sensory evaluation applications in business. For the entry-level professional or the undergraduate taking a first course in sensory evaluation, Chapters 1 and 2 provide an introduction to the topic, while Chapters 5, 6, and 7 describe the various test methods. For experienced individuals seeking to expand their perspective, Chapters 3, 4, and 8 will be especially helpful.

Numerous individuals and companies directly and indirectly provided assistance in the development of the ideas expressed in this book as well as the opportunity to put these ideas into practice. In particular we wish to acknowledge the contributions of Jean Eggert of Kraft, Inc.; Robert Boone, Carole Vohsen, and Geralyn Basinski of Ralston Purina; Emer Schaefer of S. C. Johnson & Son, Inc.; Daryl Schaller, Jan Michaels, and Jean Yamashita of the Kellogg Company; Robert Brieschke and Lenore Ryan of Kimberly-Clark Corporation; Kay Zook of the Quaker Oats Company; Margaret Savoca of R. J. Reynolds Tobacco Company; Jan Detwiler of Olympia Brewing Company; and Erik von Sydow of Nordreco AB.

Our associates also provided thoughts and assistance at various times. In particular we wish to acknowledge the contributions of Jean Bloomquist of our staff; Professors Rose Marie Pangborn, Edward B. Roessler, and Howard Schutz of the University of California at Davis; Birgit Lundgren of the Swedish Food Institute; and Dr. Richard Singleton of SRI International. We wish to express our appreciation to Marjorie Sterling-Stone who typed many of the drafts of this book and provided the comments needed to make it a more understandable text. Special thanks are due to Raymond Andersen who prepared the graphics. Herbert Stone also wishes to acknowledge the intellectual support and guidance provided by the late Professor George F. Stewart, who through the years encouraged him in this effort.

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## I. INTRODUCTION AND OBJECTIVE \_\_\_\_\_

Measuring the sensory properties and determining the importance of these properties as a basis for predicting acceptance by the consumer represent major accomplishments for sensory evaluation and for that company able to exploit this knowledge and this capability. These achievements have been possible as a direct result of recent advances in sensory evaluation, in the application of contemporary knowledge about the measurement of human behavior, and in a more systematic and professional approach to the testing process. Most of these accomplishments have been achieved within the confines of existing businesses and within the technical and marketing structures of those organizations that have recognized the unique contributions of sensory evaluation. While it would be encouraging if these accomplishments were routine, they do in fact represent exceptions—recognition that has been received in only a few situations and even fewer companies. They are primarily attributable to the efforts of relatively few individuals within organizations who have championed the inclusion of sensory information in product business decisions and have committed themselves to making sensory evaluation an integral part of a company's business. For the most part, advances have been slow, not so much because available test procedures and related resources have been inadequate, but rather because both company managers and sensory professionals have failed to recognize the

usefulness of the sensory function and/or the sensory professional has been unable to demonstrate the benefits of the information. Thus, in practice sensory evaluation has been used in very limited ways, if at all, or the resource has been ignored altogether and this situation has allowed other business groups (e.g., marketing research) to assume responsibility for product sensory evaluation activities without fully appreciating the complexities of the sensory process or the consequences of combining procedures and practices.

Over the years, numerous efforts have been made to develop a more permanent role for sensory evaluation in business and specifically in the more typical, technical environment. Examination of the technical and trade literature shows that progress in the development of sensory evaluation and sensory resources has been cyclical, with an acceleration in the trend over the past decade. Much of the impetus for the recent growth in sensory evaluation appears to have come from selected sectors of the economy, notably foods and beverages (Amerine *et al.*, 1965; Boggs and Hansen, 1949; Pangborn, 1964; Piggott, 1984; Tilgner, 1971; Williams and Atkin 1983). In their textbook on sensory evaluation, Amerine *et al.* (1965) called attention to the importance of flavor to the acceptance of foods and other products, the use of flavor-related words in advertising, and the extent to which everyday use of the senses is largely unappreciated. Perhaps a secondary benefit of the consumer's concern for food safety has been their awareness of the sensory aspects of the foods they purchase and consume.

It is apparent that current interest in sensory evaluation reflects a more basic concern than simply being able to claim use of sound sensory evaluation methodologies. In a paper published in 1977, Brandt and Arnold described the results of a survey on the uses of sensory tests by food product development groups. Their survey provided insight to some of the basic issues facing sensory evaluation. The results of the survey were especially notable for the extent of the awareness of sensory evaluation by the respondents. Of 62 companies contacted, 56 responded that they were utilizing sensory evaluation. However, descriptions of tests being used revealed that confusion existed about the various methods; for example, it was found that the triangle test (a type of discrimination test) was the most popular, followed by hedonic scaling (a type of acceptance test) and paired comparison (either an acceptance test or a discrimination test). Since these methods and the other methods mentioned in the survey provide different kinds of information, it is not possible to evaluate the listing other than to comment that the groups in most companies contacted appeared to be using a variety of procedures.

Also, there was confusion about accepted test methods and the information that each provides. For example, single-sample presentation is not a test method, yet 25 of the 56 companies responded that it was one of the test methods in use. It is in fact a serving procedure and such responses may reflect poorly worded or misunderstood questions in the survey. Another example of the confusion is "scoring," which was said to be in use by only seven of the 56 companies contacted. However, all sensory tests entail some sort of scoring, and thus this particular category should have been excluded from the questionnaire or clarification requested by the authors. Statistical tests included in the survey elicited similarly confusing responses. The failure to define the terms



confirms that the food industry utilizes sensory evaluation but there is confusion as to what methods are used and for what applications. While similar types of surveys have been done since (most have not been widely publicized, having been done by the Institute of Food Technologists' Sensory Evaluation Division and reported in their newsletter), the general conclusions have not altered very much even among professionals in the field; in other words, sensory evaluation as a science is not well understood, methods are not always used in appropriate ways, results are easily misused, and there is a dearth of qualified professionals in the field. As noted above, more books on sensory evaluation continue to be published; however, the science still has not achieved a status commensurate with its potential. Similarly, its role within individual companies is far from clear. One of the goals of this text is to provide a perspective on all these issues and how one should develop resources and integrate them into the business environment. This is not to imply that the scientific basis of sensory evaluation is overlooked. In fact, considerable attention is given to the science of sensory evaluation because without it, any use of sensory information will be seriously compromised.

A focus of this book is on a systematic approach to the organization, development, and operation of a sensory program in a business environment. While most emphasis is directed toward the more practical aspects of sensory evaluation and approaches to implementing a respected and credible program, attention also is given to more fundamental, underlying issues, including a comparison of specific test methods, experimental design, the reliability and validity of results, and related topics. From a sensory evaluation perspective, the twin issues of reliability and validity are of paramount importance, and are integral to developing a credible program that provides actionable recommendations. From a business perspective, the latter usually looms as most important, providing actionable results. Credibility also is important and relates to the trust that others will place on results and recommendations from a sensory test and the extent to which managers will act on those recommendations. The idea that volumes of data will convince one's peers and superiors is not an approach that is viable, particularly in the world of business. Sensory professionals must communicate information clearly to ensure that superiors, peers, and subordinates understand what was done and what the results mean in terms of meeting that test's specific objective.

The reader should clearly see the importance of the relationship between reliability and validity of results and the credibility assigned to sensory recommendations, and in a global sense, the credibility of a sensory program itself. It is logical to assume that a test result should speak for itself, and that quality information will be heard, understood, and acted on accordingly; however, the opposite can and does occur a sufficient number of times to directly impact on the effective utilization of sensory evaluation. Important questions are raised as to why sensory information is not better understood and, therefore, better used. Whether this situation reflects a basic lack of understanding of results from a test and/or a lack of understanding of the role of sensory evaluation in business is not clear. It would appear there is no single or simple answer. However, this situation can be better understood if one considers the nature of the sensory evaluation process. Product evaluation is a multistep process in which a group