Technical Report
How to Find Optimal Combinations of Brand Components
...using Graph Theoretical Analysis to find optimal combinations from an astronomical number of possibilities... (pages 3-4)

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  Developing Consumer Relevant Action Standards for Sensory Difference Testing
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  April 7 - 9, 2014
  at The Greenbrier, White Sulphur Springs, WV
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Mission Statement: To develop, apply, and communicate advanced research tools for human perceptual measurement.

President's Message
Advertising Claims Support

We will be presenting our annual advertising claims support course next April and details can be found at the end of this newsletter. We have a wonderful group of speakers who have years of experience in judging or litigating false advertising. This year we have included a section on claims litigation in Canada, which Anita Banicevic will discuss. Anita was part of a team that successfully defended Rogers Communications in an advertising case brought by the Commissioner of Competition in Canada. We will also present new material on consumer takeaway surveys.

We have been publishing technical reports on a quarterly basis in our newsletter since 1998. In this issue, for instance, we discuss the application of graph theory to find optimal combinations of brand components based on a study conducted in collaboration with Carolyn Corbett of CRG Global. In order to create a single source for the best of these reports, we have compiled 48 of them in a new book entitled “Tools and Applications of Sensory and Consumer Science” which can be ordered from our website.

Best regards,
Daniel M. Ennis
President, The Institute for Perception

P.S. Please encourage all senior undergraduate or graduate research students to submit their entry for the 2013 Institute for Perception Student Award. Applications must be postmarked or timestamped by January 18, 2014. Complete details about this award can be found at www.ifpress.com/student-award.

WHAT WE DO:

Client Services: Provide full-service product and concept testing for product development, market research and legal objectives
Education: Conduct internal training, external courses, and online webinars on product testing, sensory science, and advertising claims support
IFPrograms*: License proprietary software to provide access to new modeling tools
Research: Conduct and publish basic research on human perception in the areas of methodology, measurement and modeling

COURSE CALENDAR:

April 7 - 9, 2014 The Greenbrier - White Sulphur Springs, WV
(2.5 DAYS): Advertising Claims Support: Case Histories and Principles
(See pages 5, 6, & 7 for course details.)

May 19 - 23, 2014 The Powerscourt Hotel - Wicklow, Ireland
Course 1 (2 DAYS): Internal Sensory Testing: Tetrad Test, Power, and Consumer Relevance
Course 2 (2.5 DAYS): Drivers of Liking®: Principles and Applications

WEBINAR CALENDAR:

December 12, 2013 Developing Consumer Relevant Action Standards for Sensory Difference Testing
March 20, 2014 Developments in Applicability and CATA Scoring
June 19, 2014 Precision of Measurement in Sensory Difference Testing

RECENTLY PUBLISHED PAPERS:

The Institute for Perception will offer two courses in “The Garden of Ireland” - Wicklow (just south of Dublin) - from 19-23 May 2014. These courses have been developed for technical and supervisory personnel in sensory evaluation, market research, product development, process development, quality assurance, marketing, legal, and general management currently working in consumer product companies.

The courses will be held at the Powerscourt Hotel and will be taught by Dr. Daniel Ennis, Dr. Benoît Rousseau, and Dr. John Ennis with invited speakers: Frank Rossi of Kraft Foods and Pieter Punter of OP&P Product Research.

**COURSE 1: MAY 19 - 20, 2014**

**Internal Sensory Testing: Tetrad Test, Power, and Consumer Relevance**

In this 2-day course, you will learn the five concepts critical to any successful sensory discrimination testing program, including statistical power and consumer relevance. Through the use of a common framework, you will discover why the tetrad test is a better alternative to the commonly used triangle and duo-trio methodologies and how you can successfully make the switch for internal and consumer-based testing purposes.

**Topics: Monday - Tuesday**

- Difference testing methods: \( m\)-AFC, triangle, duo-trio from discrimination tests
- Power and sample sizes for discrimination methods
- Proportion of discriminators in the population
- Replicated testing: Beta-binomial models
- The tetrad test: A cost saving alternative to the triangle test
- Statistical basis for management decisions
- Establishing consumer relevance
- Setting sample sizes to maximize decision accuracy
- When to switch from the triangle to the tetrad protocol
- Relating discrimination test and rating results to maximize learning

**COURSE 2: MAY 21 - 23, 2014**

**Drivers of Liking®, Principles and Applications**

In this 2.5-day course, learn to “see” the market from your consumers’ perspective as you develop an understanding of similarity, Drivers of Liking®, and Landscape Segmentation Analysis®. This course will focus on the planning of consumer hedonic investigations and the analysis of data collected in typical category appraisal projects. You will be introduced to recently developed novel combinatorial tools that can be used effectively for optimal product selection.

**Topics: Wednesday - Friday**

- Introduction to sensory and Drivers of Liking® spaces
- Just-about-right (JAR) and ideal point models
- Mapping hedonic data
- Introduction to combinatorial tools and their applications
- Factor analysis, external preference mapping
- Introduction to Landscape Segmentation Analysis®
- How to identify Drivers of Liking®
- Dimensionality of LSA: 2-D vs. 3-D
- Segmentation and demographic map ellipses
- LSA and internal preference mapping (IPM): the issue of satiety
- Portfolio optimization
- Predicting product success from LSA results
- Blind vs. branded data, benefits
- Motivations for product consumption
- Drivers of perception
- Usage occasions, product and concept fits
- Beyond liking to other emotional states
- Deciphering the language of emotions and development of an emotion lexicon
- LSA maps of emotion terms and states
- Graph Theoretic Analysis (GTA) to develop an emotion lexicon

**Tools and Applications of Sensory and Consumer Science**

48 Technical Report Scenarios Based on Real-life Problems

This book organizes and compiles our most significant and useful technical reports from the last 15 years. With a new index and updated tables, this book is a must-have tool for professionals in product testing, consumer research, and claims support. Readers will easily relate to the issues and the corresponding resolutions that are discussed in each concise, two-page scenario. What makes this book unique is its story-telling style based on scenarios that can take place within any consumer products company.

Drs. Daniel Ennis, Benoît Rousseau and John Ennis use their combined expertise to guide readers through problems in areas such as:

- Difference Tests
- Ratings and Rankings
- Landscape Segmentation Analysis®
- Claims Support
- Combinatorial Tools
- Probabilistic Multidimensional Scaling
- Drivers of Liking®
- Optimizing Product Portfolios

The technical content behind each scenario has been kept to a minimum so that ideas can be absorbed easily, but there is plenty of opportunity to pursue each account in more detail. 27 tables for product testing methods have been included so the reader can interpret results from discrimination methodologies such as the tetrad test, the triangle test, the same-different method, the duo-trio test, replicated testing, and others.

163 pgs., $95 (plus shipping and VA sales tax, where applicable)
Background: Consumer products are often viewed as combinations of components drawn from categories such as features, benefits, and imageries. Successful marketing of brands depends on skill in choosing these combinations. The staggering number of combinations that can result from even a relatively small number of components is not always appreciated. For example, with only 60 components in these combinations, there are over a quintillion ($10^{60}$) of them - if there was one penny for every combination, the pennies would cover the surface of the earth twice if laid out side by side! Nevertheless, there are techniques available to consider these astronomically large numbers of alternative combinations to find the single best combination or a small group of actionable alternatives.

Although regression-based techniques such as conjoint analysis are useful in situations where the numbers of components are relatively small, such tools are not well-suited to handling problems of the larger type described above. Fortunately, these problems can be analyzed using techniques from the mathematical field of graph theory. Graph theory has grown substantially because of its applications to internet search, social networking, and national security. The purpose of this report is to demonstrate the use of graph theory to optimize products built around sparkling fruit beverages.

Scenario: You are a consumer insights manager within a soft drink company that plans to launch a line of carbonated fruit juice beverages. At this preliminary stage of development, you are considering 15 possible flavors, 22 benefits, and 23 imagery variables within this product line. This number of items is typical of projects of this type on which you work, and you plan to allow combinations of items within categories (e.g., two flavors mixed together) as well as across categories (e.g., a flavor and a benefit). The goal of the project is to find high quality combinations of at most six items, with at least one item from each category included. These combinations of at least one flavor, at least one benefit, and at least one imagery will serve as starting points for future product development.

For this project, there are 60 components and it is immediately apparent that size considerations will prevent you from using conjoint analysis. An alternative is to rank the items within categories and choose the most appealing items. But this approach would ignore the compatibility or incompatibility of items within combinations and would fail to discover unusual products with high appeal.

Graph Theory: Graph theory is the study of connections between items and we consider a connection to be a pairwise relationship between them. In the beverage project, these connections represent compatibility, but connections could represent suitability, appropriateness, social acquaintance, or any other relationship that either holds or does not hold for each pair of items under consideration.

Once the connections within a set of items are determined, we use the connections between the items to form a graph. See Figure 1. The information as to which items are connected can be stored in a connectivity matrix - Table 1 corresponds to the graph in Figure 1.

### Table 1. Adjacency matrix corresponding to the graph in Figure 1.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>B</td>
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<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>0</td>
<td>1</td>
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<td></td>
</tr>
</tbody>
</table>

### Table 2. Flavors, benefits and imageries.

| Flavors | Apple, Blackberry, Blueberry, Cherry, Grape, Grapefruit, Lemon, Lime, Mango, Orange, Peach, Pineapple, Pomegranate, Raspberry, Strawberry |
| Benefits | All-natural, Becoming popular, Clean-tasting, Delicious, Energizing, Fizzy, Goes down easy, Good when hanging out, Good-tasting, Invigorating, Low-carb, Refreshing, Relaxing, Reviving, Rewarding, Satisfying, Social, Stimulating, Thirst-quenching, Uplifting, No harsh taste, Would recommend |
| Imageries | Abundance, Admire, Appeals to me, Aromatic, Authentic, Breezy, Classic, Crisp, Desperate, Different, Distinctive taste, Fresh, Healthy, Let loose, Light, Masculine, Patriotic, Quality, Robust, Smooth, Sophisticated, Strong, Strong heritage |

Within a graph, a clique is a collection of items that is fully connected. See Figure 2. In general, cliques may or may not be contained within larger cliques, but a maximal clique is one that is not contained in any larger clique. Applying this perspective to consumer science, we consider a product to be a combination of the component choices it represents, and we look for cliques.

The Beverage Problem: Table 2 contains the components in each of the three categories - flavors, benefits, and imageries - from which the product combinations will be formed. We need only consider pairs of components instead of full combinations and this fact allows us to only consider 1770 possible pairs. Even so, this is still a reasonably large number of pairs (more than you could ask a single consumer to evaluate in a single session) and your first step is to further reduce the problem size. Inspection of Table 2 shows significant redundancy (e.g., invigorating = energizing, strong = robust). Thus, if some components could be eliminated as redundant then it may not be necessary to evaluate all 1770 pairs.
Independent Sets: One way to reduce redundancy is to consider which items are not related, and to search for sets of items that are fully unconnected. These “anti-cliques” are called independent sets. Independent sets occur when there are no connections at all between the items of a set. By reversing the connections in a graph to form the so-called complement graph, we can find independent sets easily by finding cliques in the complement. Figure 3 shows a graph and its complement. In your project, you plan to use these ideas in a preliminary experiment, in order to identify sets of items that are as non-redundant as possible.

Figure 3. A graph and its complement.

Reducing Redundancy: Within the 15 flavors there are 105 pairs, within the 22 benefits there are 231 pairs, and within the 23 imageries there are 253 pairs. You arrange for internal experts to rate how similar or different the pairs of components are, within each category. After aggregating this similarity data, you conduct a search for independent sets within each category to find subsets of flavors, benefits, and imageries that are as different as possible from each other, according to the assessments of your internal experts. This search yields the lists of components given in Table 3. Since there are now only 300 pairs within and across categories. It is now possible to design a consumer study in which each consumer evaluates each pair in a single session.

Application of Graph Theory to the Beverage Problem: In your consumer study, you present pairs of components along with the question:

“In thinking about sparkling fruit juice beverages, for each pair of items please indicate whether you think they go well together.”

The pairs of components are presented in a forced-choice CATA format, in which 30 pairs are shown at a time and consumers are forced to select “Yes” or “No” for each pair. You obtain responses from 1000 consumers in a nationwide internet survey using a randomized design. From these responses, you construct a compatibility matrix which shows the degree to which the pairs of components are compatible. Using a thresholding procedure, graph theory can now be applied to find cliques of size 6 but none of size 7, subject to the constraint that at least one component must come from each category. In the initial analysis, you discover that “All-natural” is in every maximal clique, so you decide that it should be used in every consumer communication. You then remove all pairs involving “All-natural” and re-run the analysis. Table 4 shows the top five of the 25 combinations identified by this graph theoretic search, when the combinations are ordered by overall compatibility.

Table 3. Flavors, benefits and imageries after independent set analysis using graph theory.

<table>
<thead>
<tr>
<th>Flavors</th>
<th>Benefits</th>
<th>Imageries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple, Blueberry, Cherry, Lime, Mango, Orange, Peach, Pineapple, Pomegranate</td>
<td>Goes down easy, Relaxing, Satisfying</td>
<td>Smooth</td>
</tr>
<tr>
<td>Benefits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All-natural, Fizzy, Goes down easy, Low-carb, Relaxing, Reviving, Satisfying, Social</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imageries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abundance, Authentic, Breezy, Classic, Crisp, Healthy, Let loose, Smooth</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4. The best five of 25 maximal cliques that have at least one component from each category after dropping “all-natural.”

Table 4 shows the top five of the 25 combinations identified by this graph theoretic search, when the combinations are ordered by overall compatibility.

References and Notes
Advertising Claims Support
Case Histories and Principles

How do you compete effectively in an increasingly challenging environment? Comparative advertising can improve sales, but how do you address false claims or challenges made by your competitors? Claims support is a critical business focus for many companies in categories with aggressive competitors.

The purpose of this course is to raise awareness of the issues involved in surveys and product tests to provide the type of evidentiary support needed in the event of a claims dispute.

The course speakers have decades of experience as instructors, scientific experts, jurors, and litigators in addressing claims with significant survey and product testing components. Actual NAD and litigated cases will be used to examine and reinforce the information discussed.

* Approximately 12 credits for CLE: Accreditation will be sought for registrants in jurisdictions with CLE requirements.

**MONDAY** (APRIL 7, 8am - 4pm)

8:00 – 9:00 | Introduction
- Introduction and scope
- Falsity, injury, and puffery - with examples
- “To sue or not to sue”
- Class action lawsuits

9:10 – 10:00 | NAD and Self-Regulation
- NAD process and self-regulation
- Five questions
- NAD and standard-setting specifications – what role they play in NAD decisions with examples
  - Case 1: LG Electronics USA, Inc. (Cinema 3D Television and 3D Glasses) NAD Case #5416 (2012)

10:10 – 11:00 | ASTM Claims Guide; Methods and Data
- Review of the ASTM Claims Guide
- Types of claims: Superiority (ratings, counts, ratios), unsurpassed, equivalence (parity), non comparative
- Types of methods: Threshold, discrimination, descriptive, hedonic
- Types of data: Counts, ordinal (ranks), category scales, interval scales, ratio scales

11:10 – Noon | Sensory Intensity and Preference; Attribute Interdependence
- Sensory intensity and how it arises
- Liking and preference and how they differ from intensity
- Attribute interdependencies
  - Case 2: The Clorox Co. (Clorox® Toilet Wand™ System) NAD Case #4306 (2005)
  - Case 3: Bausch & Lomb, Inc. (ReNu with MoistureLoc) NAD Case #4385 (2005)
  - Case 4: Playtex Products, Inc. (Playtex Beyond Tampons) NAD Case #4364 (2005)

Noon – 1:00 LUNCH

**TUESDAY** (APRIL 8, 8am - 4pm)

8:00 - 9:00 | Consumer Takeaway Surveys
- What an advertisement says vs. what it communicates
- How to design a valid survey
- Identifying and removing sources of bias

9:10 – 10:00 | Analysis – Interpretation and Communication
- The essence of hypothesis testing
- Analysis of variance, t-tests, non-parametric tests, scaling difference and ratings data
- Statistical significance and confidence bounds
- Understanding by jurors
  - Case 13: Summit Vet Pharm, LLC (Vectra 3D and Vectra) NAD Case #5090 (2009) and NARB Panel #157 (2010)

10:10 – 11:00 | Test Power
- Meaning of power
- Planning experiments and reducing cost
- Sample sizes for claims support tests
- Managing risk in testing: Advertiser risks, competitor risks
  - Case 14: Church & Dwight, Co., Inc. (Brillo Steel Wool Soap Pads) NAD Case #3605
ADVERTISING CLAIMS SUPPORT COURSE FEE
April 7 - 9, 2014 (2.5 days)............................. $1,975*

* A 20% discount will be applied to each additional registration from the same company.
* The Institute for Perception offers reduced or waived course fees to non-profit entities, students, judges, government employees and others. Please contact us for more information.

Fee includes all course materials, continental breakfast, break refreshments, lunches, and group dinners.

HOW TO REGISTER
Register online at www.ifpress.com/short-courses where payment can be made by credit card. If you prefer to be invoiced, please call 804-675-2980 for more information.

LOCATION & HOTEL RESERVATIONS
The program will be held at The Greenbrier® in White Sulphur Springs, West Virginia. Renowned for its standard of hospitality and retreat-like setting, this hotel is an ideal location for executive meetings and consistently receives a AAA 5-Diamond rating.

Lodging is not included in the course fee and participants must make their own hotel reservations. A block of rooms will be held at The Greenbrier, until 4 weeks before the program, at a special rate of $195 per night. To make a reservation, please call 1-877-661-0839 and mention you are attending The Institute for Perception course. (Note: the special rate is not available through online reservations.) To learn more about The Greenbrier, visit their website at www.greenbrier.com.

TRANSPORTATION
Nearby airports include the Greenbrier Valley Airport (LWB, 15 min.), Roanoke, VA (ROA, 1 hr. 15 min.), Beckley, WV (BKW, 1 hr.), and Charleston, WV (CRW, 2 hrs.).

CANCELLATION POLICY
Registrants who have not cancelled two working days prior to the course will be charged the entire fee. Substitutions are allowed for any reason.

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**SCIENTIFIC TEAM**

**Dr. Daniel M. Ennis** is the President of The Institute for Perception. Danny has more than 35 years of experience working on product testing theory and applications for consumer products. He has doctorates in food science and mathematical & statistical psychology. He has published extensively on mathematical models for human decision-making and was the first to show that humans possess a transducer in the chemical senses. Danny is the 2013 recipient of the *Sensory and Consumer Sciences Achievement Award* from IFT and also the ASTM 2013 David R. Peryam Award in recognition of “outstanding contributions to the field of basic and applied sensory science.” Danny consults globally and has served as an expert witness in a wide variety of false advertising cases.

**Dr. Benoît Rousseau** is Senior Vice President at The Institute for Perception. Benoît received his food engineering degree from AgroParisTech in Paris, France and holds a PhD in sensory science and psychophysics from the University of California, Davis. He has more than 20 years of experience in managing projects in the field of sensory and consumer science, actively working with clients in the US, Asia, Latin America, and Europe. His theoretical and experimental research has led to numerous journal articles as well as several book chapters. Benoît is also well known for his advanced presentation skills, where his use of sophisticated visual tools greatly contribute to the success of the Institute for Perception communications and short courses.

**Dr. John M. Ennis** is Vice President of Research Operations at The Institute for Perception. John received his PhD in mathematics and also conducted post-doctoral research in cognitive neuroscience at the University of California, Santa Barbara. He is the winner of the 2013 *Food Quality and Preference Award* for “Contributions by a Young Researcher.” John has published in statistics, mathematics, psychology, and sensory science. He has a strong interest in the widespread adoption of best practices throughout sensory science, serves on the editorial board of the Journal of Sensory Studies, and is chair of the ASTM subcommittee E18.04 - “Fundamentals of Sensory.”

**LEGAL TEAM**

**National Advertising Division (NAD)**

**Kathleen (Kat) Dunnigan** is Senior Staff Attorney with the National Advertising Division, having joined the NAD in 2008. As an officer in the United States Merchant Marines, she earned an engineering degree from S.U.N.Y. Maritime College, and her law degree from NYU Law School. Kat has worked for the Legal Aid Society’s Juvenile Rights Division, the Center for Appellate Litigation, and Center for HIV Law and Policy. She has also litigated employment discrimination and civil rights claims and been involved in many employment cases before the New Jersey Supreme Court.

**Anita Banicevic** is a partner at Davies Ward Phillips & Vineberg in the Competition & Marketing and Distribution practice. She has represented clients in contested misleading advertising proceedings and investigations initiated by Canada’s Competition Bureau, and advises domestic and international clients on Canadian competition and advertising and marketing law. Anita is currently a member of the Executive Committee of the Canadian Bar Association’s Competition Law Section and Co-Chair of the Compliance and Ethics Committee of the Antitrust Law Section of the American Bar Association. She holds a BAH and LLB, Law from Queen’s University, Canada.

**Christopher Cole** is the co-chair of the Advertising and Product Risk Management group of Crowell & Moring. Chris practices complex commercial litigation and advises the development, substantiation and approval of advertising and labeling claims. He has represented some of the leading consumer products companies in the world, has been lauded for his work in the defense of false advertising litigation, and has appeared many times before the NAD. He is a magna cum laude graduate of Boston University School of Law and holds biology and marine biology degrees from Yale and the University of Miami, respectively.

**Lawrence I. Weinstein** is a litigation partner at Proskauer Rose LLP, where he is co-head of the firm’s renowned False Advertising & Trademark Group. Larry is both a distinguished trial lawyer and counselor. His practice covers a broad spectrum of intellectual property law, including false advertising (Lanham Act, consumer class actions, NAD, NARB, ERSP, FTC), trademark, trade secret and copyright matters, as well as sports, art and other complex commercial cases. He is currently a member of Law360’s Intellectual Property Law Editorial Board.

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**Litigators**

**Annie Ugurlayan** is a Senior Attorney at the NAD. Since 2003, she has handled over 150 cases, with a particular focus on cosmetics and food cases. Annie is a published author, Chair of the Consumer Affairs Committee of the New York City Bar Association, a member of the Board of Directors of the New York Women’s Bar Association Foundation, and other local and national bar associations. Annie is fluent in French and Armenian, and proficient in Romanian. She is a graduate of Hamilton College and Hofstra University School of Law.

**David H. Bernstein**, a litigation partner at Debevoise & Plimpton LLP, is described by Chambers USA (2010) as “the doyen of trademark and false advertising law” and Managing Intellectual Property (2011) as the “Outstanding IP Litigator of the Year.” David regularly represents clients in advertising disputes in courts nationwide, before the NAD, NARB and television networks, in front of state and federal regulators, and in arbitration proceedings. He is the co-author of the treatise The Law of Advertising, Marketing and Promotion and is an adjunct professor at New York University and George Washington University law schools. David is a graduate of Princeton University, the London School of Economics and Political Science, and Yale Law School.

**David G. Mallen** is a partner at Loeb & Loeb LLP where he specializes in advertising law, claim substantiation and legal issues in media and technology. He was previously the Deputy Director of the NAD where he analyzed legal, communication, and claim substantiation issues, and resolved hundreds of advertising disputes. Before joining the NAD, David practiced law at Kensington & Ressler LLC. He frequently lectures on advertising self-regulation, Green Marketing, claim substantiation and international advertising issues. David graduated from Cornell University and received his JD degree from Albany Law School of Union University.

**Internal Counsel**

**Don Lofty**, who is recently retired from S.C. Johnson & Son, Inc., specializes in anti-trust and trade regulation, with emphasis on advertising law, including practice before the NAD. He was the head of the company’s Marketing and Regulatory Legal Practice Group and managed their Legal Compliance Program. Don received his AB from Dartmouth College and his JD from Georgetown University Law Center.