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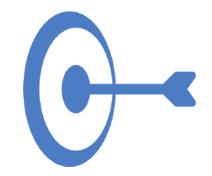
Taste Evaluation Technology

Overview

Scott Horvitz, CEO
R. Kyle Palmer, PhD, CSO

Opertech Taste Evaluation System:

A Pioneering High Throughput Approach to Taste Testing

Faster Results

Greater Accuracy

Fewer Resources

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Markets

Food & Beverage

Improve taste and discover new healthier flavor ingredients

Pet Foods
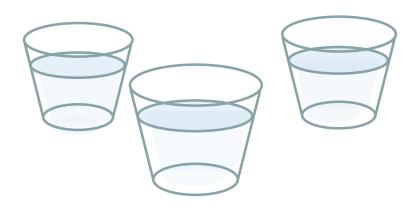
Palatability is a major driver

Pharmaceuticals

Better tasting liquid formulations

Our clientele include some of the world's largest and best known food and beverage, consumer healthcare and pharmaceutical companies.

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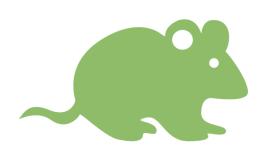
Traditional Sensory Methods
are Cumbersome

- Relatively few samples can be evaluated per test
- Many subjects are required for statistical power (20+)
- Measurements relying of sensory scaling can be inconsistent
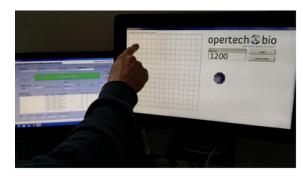- The large volumes of sample evaluated in sensory panels require significant quantities of materials

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Opertech Solution:
Universal to all Species

The First High-throughput Taste Evaluation Systems

U.S. Patent No. 8,820,265

TāStation™

Rats

- In service for early stage discovery and testing, basic research

- Testing compounds not yet approved for humans
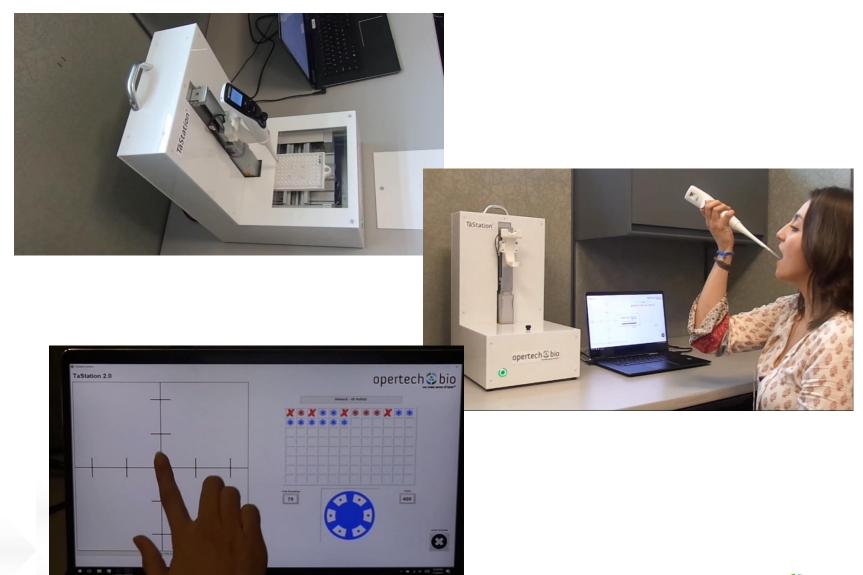
Cats and Dogs

- Development project, partnering opportunity

- Testing ingredients for the pet food industry

Humans

- In service for taste evaluation studies

- Complementing or replacing human taste panels

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Rapid Throughput Taste Discrimination
TāStation^TM 2.0

TāStation™ Advantage

- Each subject evaluates 96 samples in ~45 minutes
- Large datasets are quickly generated
- Fewer subjects are needed
- Sample volumes are small (0.2 ml)
  - Overcomes taste desensitization
  - Reduces cost of materials required for testing
  - Pharmaceutical exposure is fraction of single daily dose
- Opertech has extensive experience in evaluating
  - Sweeteners and sweetness enhancers
  - Bitterness mitigation/blocking
- Protocols are approved by an independent, accredited, Institutional Review Board (IRB)

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Proprietary Interactive Algorithms

Operant Conditioning
– Tie a consequence to the response
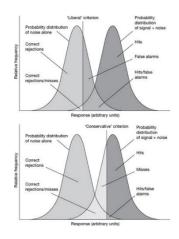 • Reward accurate performance
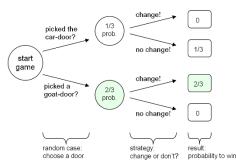 • Penalize poor performance

Signal Detection Theory
– Subject bias is inherent in sensory testing
– Identify, quantify, and control the bias

Game Theory
– Subjects make decisions about sensory stimuli
– Optimize decision strategies through algorithms

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The TāStation™

Automated High Throughput Sample Delivery

- Robotic pipette randomly selects a well from a 96-well plate
- Withdraws small volume (usually 0.2 – 1.0 ml)
- Presents pipette to subject
- Subject self-administers to the tongue

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Samples are Distributed in a 96-well Plate

- *Volumes less than a milliliter*
- *Milligram amounts of test materials*
  - *Minimizes desensitization*
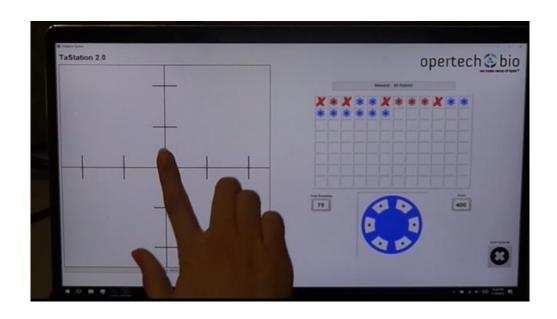 - *Minimizes costs or natural products*
  - *Minimizes pharmaceutical exposure*

- *Maximal flexibility in experimental design*
- *Ideal for concentration-response analysis and screening*

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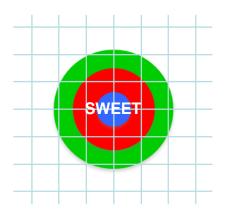
The TāStation™

Responses have Consequences

- Subjects are instructed to search for poker chips buried in a visual field
- The taste stimulus is clue to their location
- After tasting, the subject is prompted by the computer to touch the screen
- The response has a consequence—reward or penalty—then on to the next trial
- Subject completes all 96 trials in ~45 minutes

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Taste Stimuli are Mapped to Specific Coordinates on the Touch-Screen

The target is invisible to the subject

- Subjects are trained to associate a taste standard with the target locus
- Target is designed like a dart board

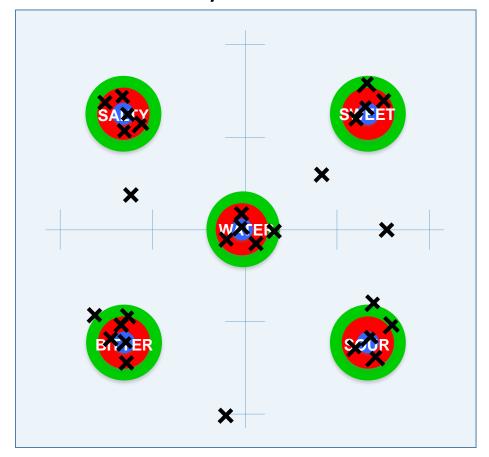

Maximum Value

Intermediate Value

Minimum Value

- Responses in the center bring the highest point value
- Point value declines with distance from center
- Penalty occasions responses made outside the target

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Responses are Registered via Touch Screen Calibrated by Taste Standards
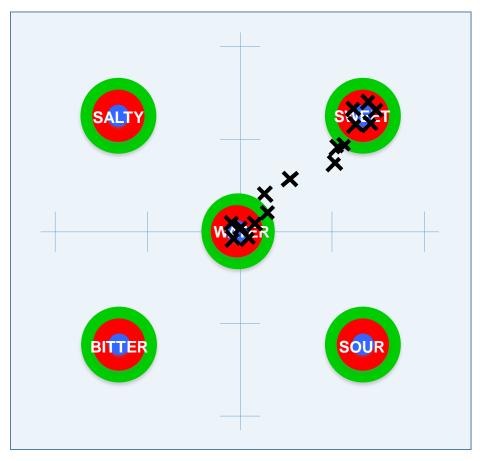

What the Subject Sees

Targets Are Invisible

- During training, subjects learn the target locations by trial-and-error
  - Correct touch responses are rewarded
  - Incorrect responses are penalized
- Responses become associated with appropriate targets

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Responses to Test Articles Distribute According to Stimulus Generalization

- Test article are randomly presented multiple times (along with control standards)
- Responses to high and low concentrations of test article tend to cluster on standard target and water target coordinates
- Responses to intermediate concentrations tend to alternate or distribute between the targets

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Taste – Touch – Consequence
(Structure of All Randomized Trial Sequences)

Hypothetical Examples

Training Session (All responses must be "correct")

Trial 1: Water – correct – reward

Trial 2: Quinine – correct – reward

Trial 3: Citric acid – error – penalty

Trial 4: NaCl – correct – reward

Trial 5: Sucrose – error – penalty

Test Session (Control standard trials must be "correct")

Trial 1: Quinine – correct – reward
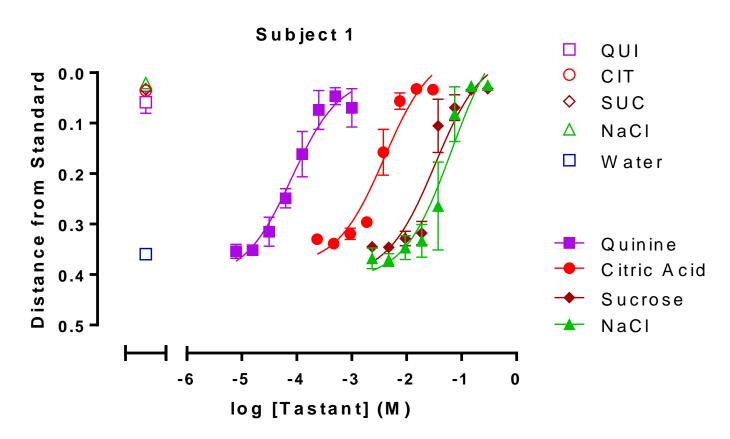
Trial 2: Water – error – penalty

Trial 3: Test article – touch anywhere – reward

Trial 4: Sucrose – correct – reward

Trial 5: Water – correct – reward

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Responses are Plotted as Distance From Standard Target
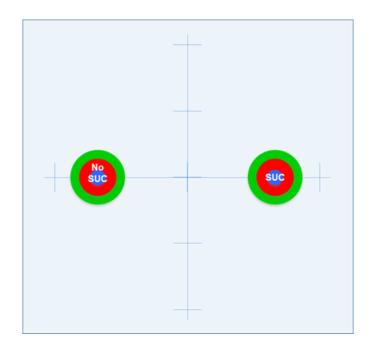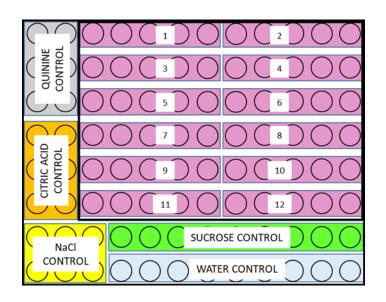## *Curve-fit Yields Concentration-Response Functions for Taste*

Complete concentration-response characterization for all four basic tastes achieved within single ~45 minute test session for a single subject
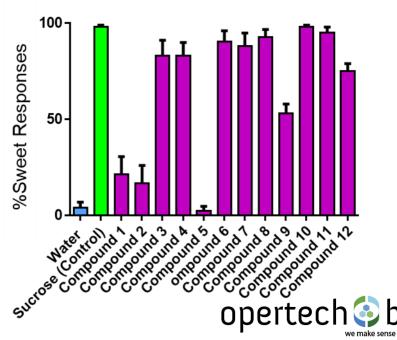
Rapid Throughput Screening for Taste Active Substances
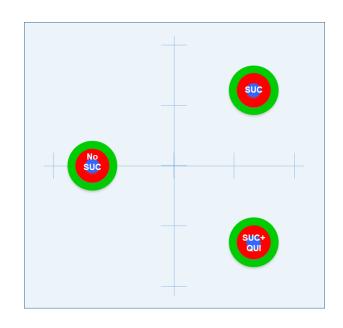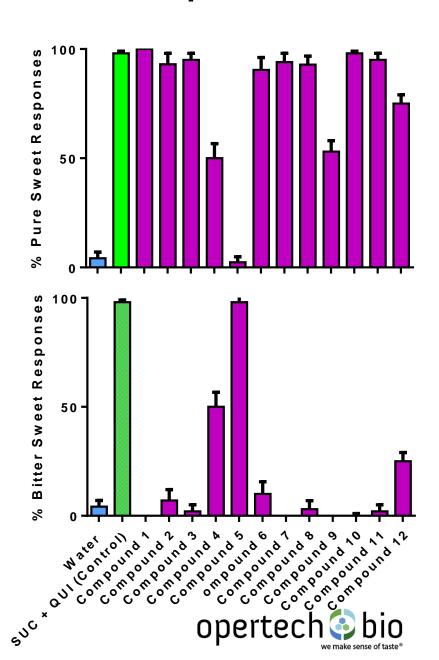
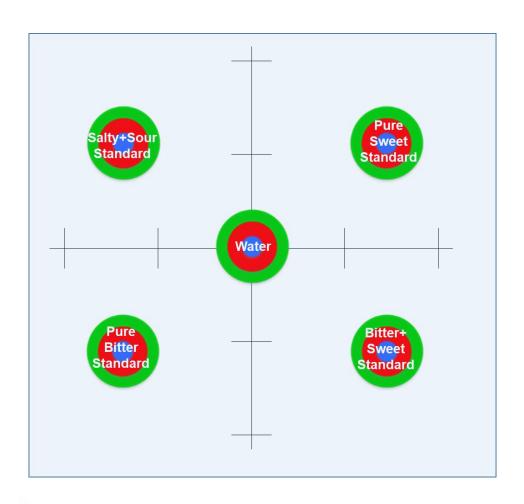Simple "Sweet vs. Not Sweet"

Screening for Complex Taste Properties

"Pure Sweet, Bitter/Sweet, or Not Sweet"
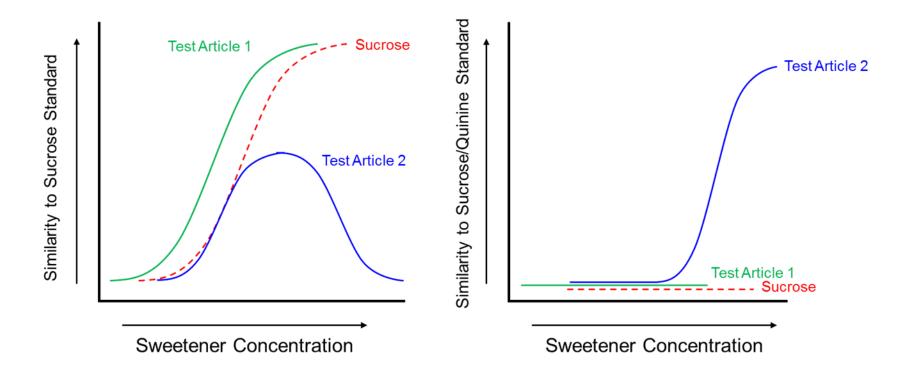
TāStation™ Applications
The Grid Can be Programmed to Accommodate Any Sensory Endpoint

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Concentration-Response Format Quantifies Taste Properties Across Entire Range of Activity

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The TāStation™ Approach

- Automated sample delivery
  - Reduce human errors
  - Reduce variability by increasing consistency
  - Increase throughput

- Small sample volumes
  - Decrease amount of materials
    - Minimizes or eliminates desensitization
    - Lower cost of ingredients
    - Lower API exposure

- Interactive algorithms
  - Algorithm operates as a game
  - Consequences are tied to each response
  - Incentivizes accuracy, repeatability
  - Fun for the subject!

- Fewer subjects, more data per subject

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Test Protocol

More Data = Greater Informative Power

Subjects Log-in to Each Test

Subject 1   Subject 2   Subject 3   Subject 4

Each Subject Generates 100s of Data Points Per Test

DATABASE

Retrieval, Mining, Analysis

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TāStation™ Applications

- **Discovery of novel flavor ingredients**
  - Ideal for evaluation of new tastants, enhancers, blockers

- **Flavor optimization**
  - Combinatorial strategy for development of best-tasting ingredient mixtures

- **Taste acuity**
  - Quantification: Identify who are the best taste testers
  - Training: Improve a person's taste-detection performance

- **Managing Subject Pool**
  - Rapid screening and evaluation of subjects prior to inclusion in a study
  - Tracking individual performances from test to test

- **Data mining**
  - Taste sensitivities and preferences across demographics

- **Preference ('Liking')**
  - Objective measure of preference (in development)

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TāStation™ Flexible Business Models

Achieve optimal arrangement for client's objective

Fee for service

- Taste evaluation of new tastants, enhancers, blockers, and formulations
- TāStation™ is portable
  - Client provides samples for testing at Opertech
  - Opertech brings TāStation™ to client for testing at their location
- Taste acuity training and quantification

TāStation™ licensing

- Apparatus and software

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Intellectual Property

Issued patents

Covering core methodology and/or apparatus

- US Patent No. 8,820,265 issued Sept 2, 2014
- Europe
- Canada

Additional patent applications

Covering specifics around human TāStation™ applications

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Thank You.

Scott Horvitz, CEO

R. Kyle Palmer, PhD, CSO

Opertech Bio, Inc.

Korman Research Pavilion
Albert Einstein Healthcare Network
5501 Old York Road
Philadelphia, PA 19141
Phone: 215-456-8765