



TāStation<sup>®</sup>

## Taste Evaluation Technology

Overview

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

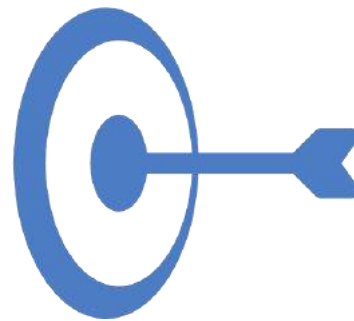


# — We Make Sense of Taste® —

A Pioneering High Throughput Approach to Taste Testing



Faster  
Results



Greater  
Accuracy



Fewer  
Resources

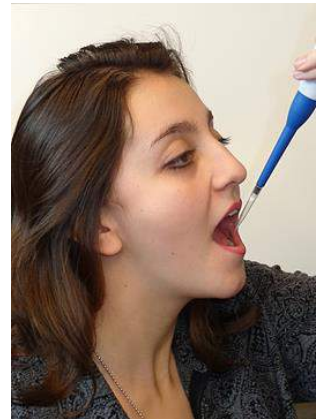
*Faster, more accurate and requires far fewer resources offering substantial savings in time and money to the food and beverage and flavor ingredient industries*

# TāStation<sup>®</sup> Advantage

- Each subject evaluates 96 samples in ~45 minutes
- Fewer subjects, more data per subject
  - Example: 12 samples x 5 replicates each x 8 subjects x 2 tests each  
**=960 data points in a typical project**
- Testing can be conducted in isolation
  - Pandemic protocol
- Sample volumes are small (0.2 ml)
  - Overcomes taste desensitization
  - Reduces cost of materials required for testing
  - Testing of precious NPs can be done with ~ 10 mg
  - Minimizes exposure and risk to subjects
    - All Opertech protocols are approved by an independent, accredited, Institutional Review Board (IRB)
- Unparalleled Experimental Flexibility
  - Many input variables at the control of the investigator
  - User-friendly program

# The TāStation<sup>®</sup> Approach

- Automated sample delivery
  - Reduce human errors
  - Reduce variability by increasing consistency
  - Increase throughput
  - Small sample volumes (0.2 ml)
- Interactive algorithms
  - Algorithm operates as a game
  - Consequences are tied to each response
  - Incentivizes accuracy, repeatability
  - Fun for the subject!
- Cloud-based database and Bluetooth/WiFi real-time communication
  - Program test design, monitor test progression, access data for analysis from any remote location
    - Local intranet option also available



# Proprietary Interactive Algorithms

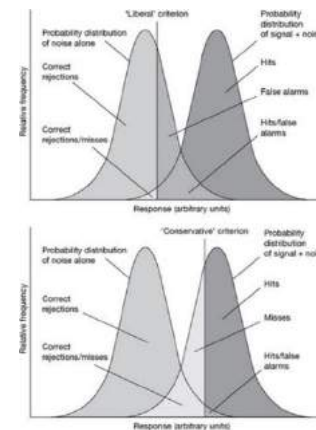
## Operant Conditioning

- Tie a consequence to the response
  - Reward accurate performance
  - Penalize poor performance



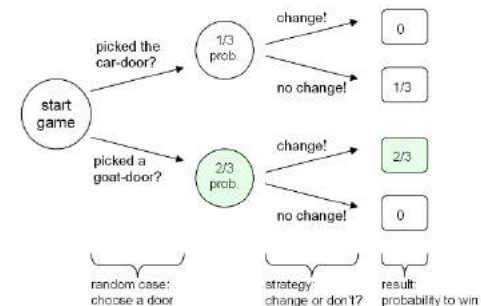
## Signal Detection Theory

- Subject bias is inherent in sensory testing
- Identify, quantify, and control the bias



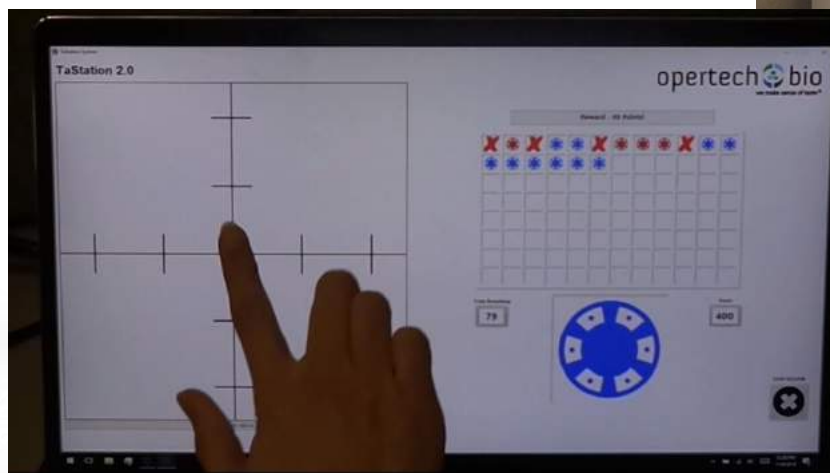
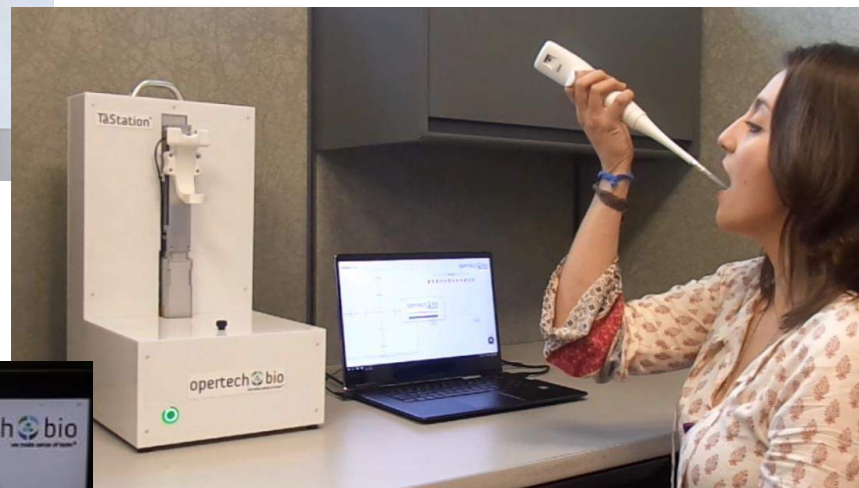
## Game Theory

- Subjects make decisions about sensory stimuli
- Optimize decision strategies through algorithms



# Opertech Solution: TāStation®

The First High-throughput Taste Evaluation System

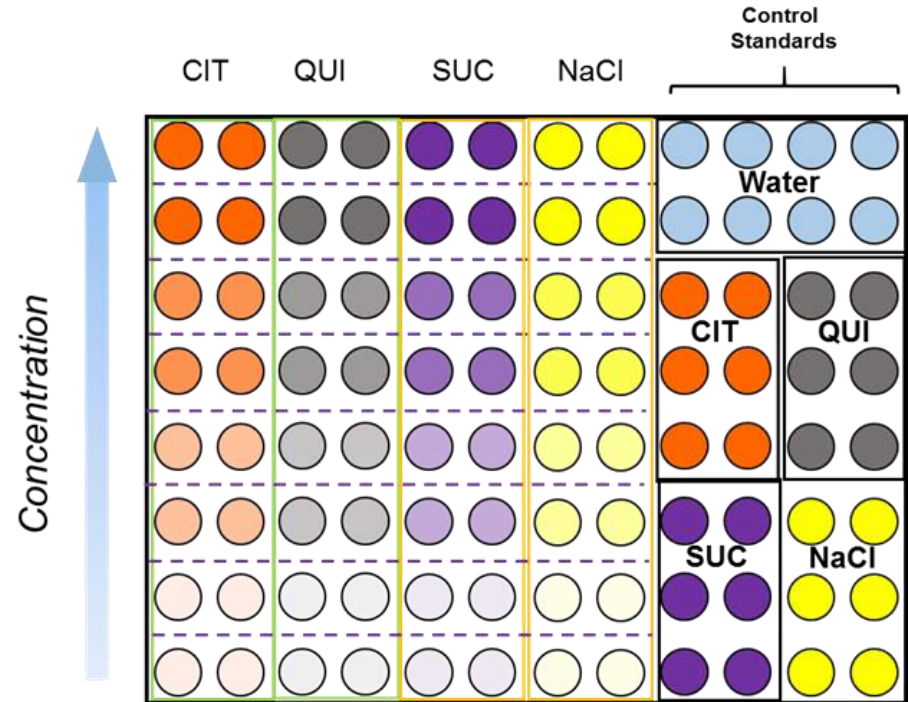
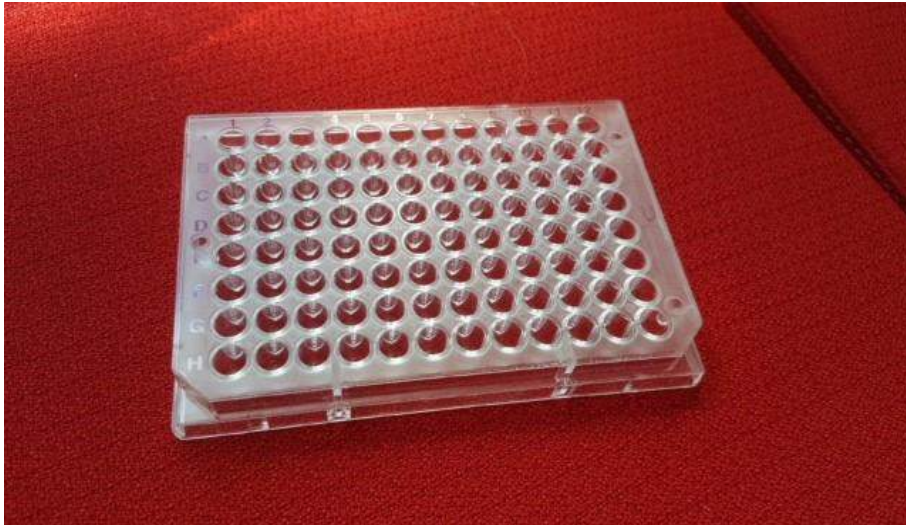


U.S. Patents No. 8,820,265, 9,841,897, and 10,542,926

opertech  bio  
we make sense of taste®



# Samples are Distributed in a 96-well Plate



- *Volumes typically 0.2 milliliter*
- *Milligram amounts of test materials*
  - *Minimizes desensitization*
  - *Minimizes costs of natural products*
  - *Minimizes exposure lowering risk to subjects*

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

# The TāStation<sup>®</sup>

## Automated High Throughput Sample Delivery

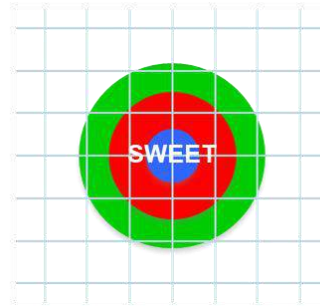


- Robotic pipette randomly selects a well from a 96-well plate
- Withdraws small volume (0.2 ml)
- Presents pipette to subject
- Subject self-administers to the tongue



# Contingencies of Reinforcement

Response have Consequences



*The target is invisible to the subject*

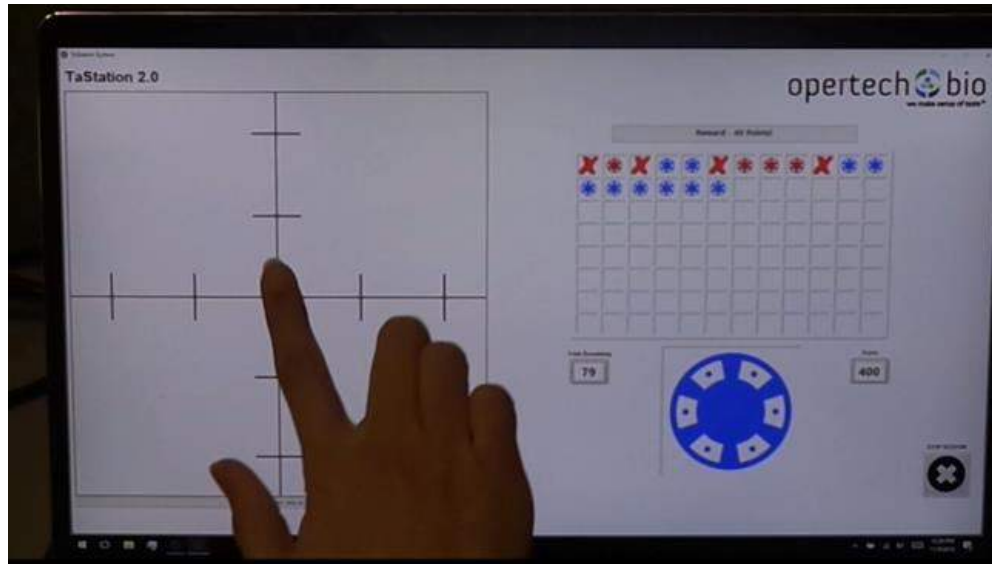
- Subjects are trained to associate a taste standard with the target locus
- Target is designed like a dart board



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

# The TāStation<sup>®</sup>

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

# TāStation<sup>®</sup> Demo

## The First High-throughput Taste Evaluation System

TāStation<sup>®</sup> Video: <https://www.youtube.com/watch?v=VneNPgZD14A&t=120s>

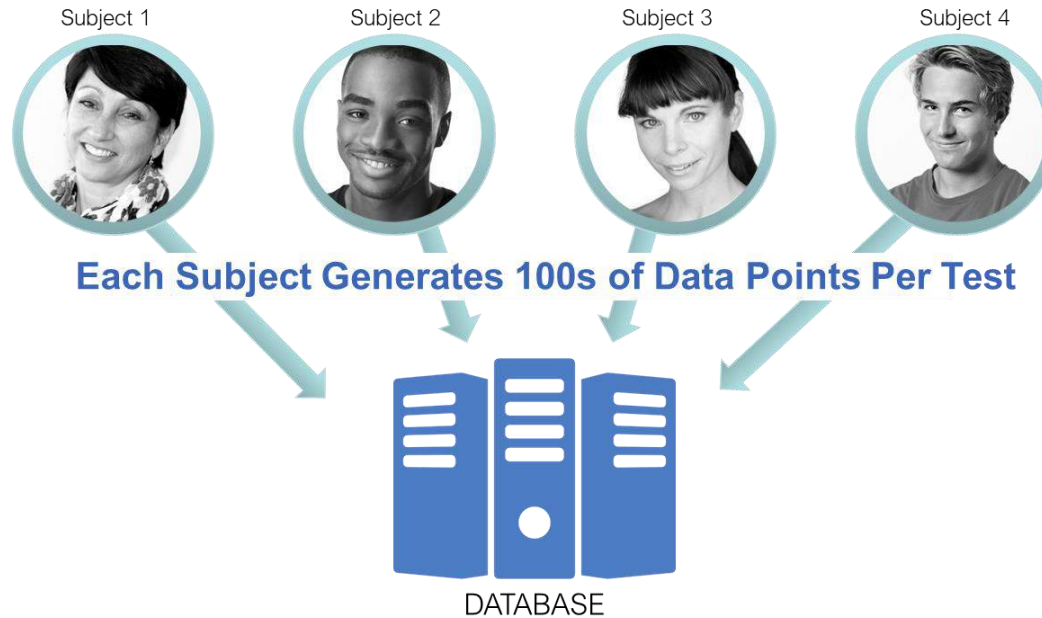


# How to Design a TāStation<sup>®</sup> Experiment

- **Determine Program Objectives (Examples)**
  - Screen natural products for sweet taste
  - Determine range of taste active concentrations
  - Determine concentration-dependence of bitter after-taste
- **Translate Subjective Descriptive Labels to Object Standards (Examples)**
  - “Pure sweet” becomes 300 mM sucrose solution
  - “Sweet with bitter after-taste” becomes a mixed solution of 300 mM sucrose plus 0.25 mM quinine

# Select a Cohort from the TāStation<sup>®</sup> Database

## Subjects Log-in to Each Test



## Retrieval, Mining, Analysis

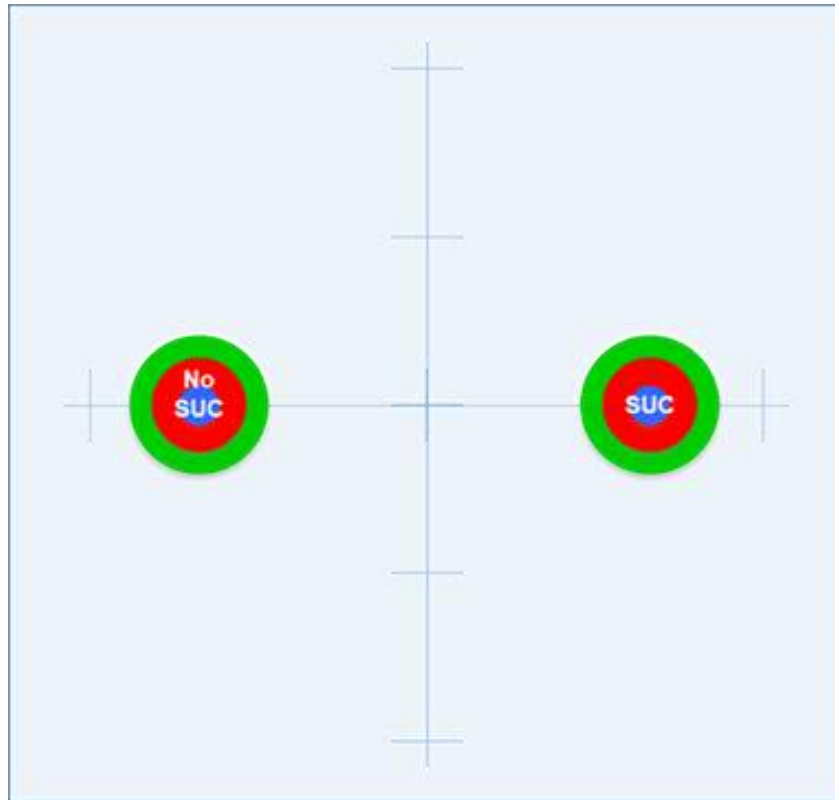
### More Data = Greater Informative Power

- All data generated by a given subject, test after test, are entered into the database through the subject's user profile
  - Taste sensitivities thereby can be matched to subject-dependent variables, such as age, gender, height and weight, zip code, etc.
- “Enriched” cohorts can be designed, composed of subjects selected from the database by specific traits of interest
  - Bitter off taste-sensitive cohort (or any other particular taste sensitivity of interest)
  - Cohort of subjects diagnosed with GERD
  - Cohort of smokers
  - Cohort from any specific region of the US or other country of origin

# How to Design a TāStation<sup>®</sup> Experiment

## *Design a Touch-screen Map*

- Example of a binary “Sweet” or “Not Sweet” test protocol
- Useful for screening NP sweeteners
- Useful for quantifying detection thresholds or difference thresholds

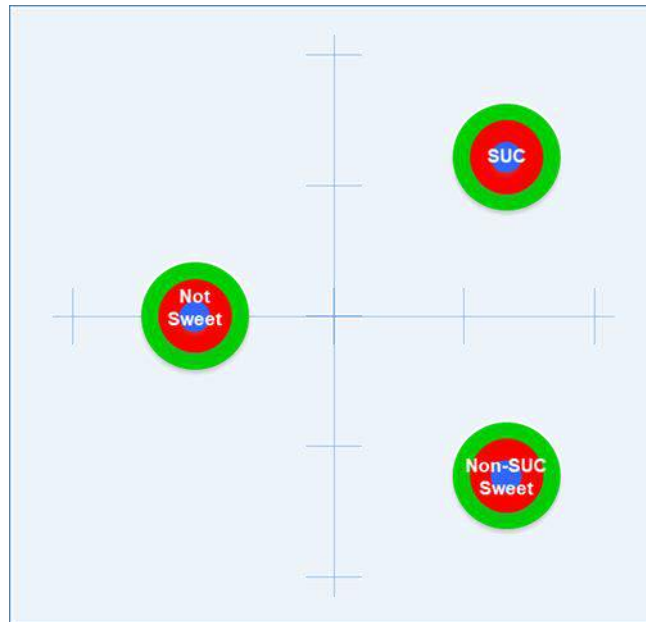




# How to Design a TāStation<sup>®</sup> Experiment

## *Design a Touch-screen Map*

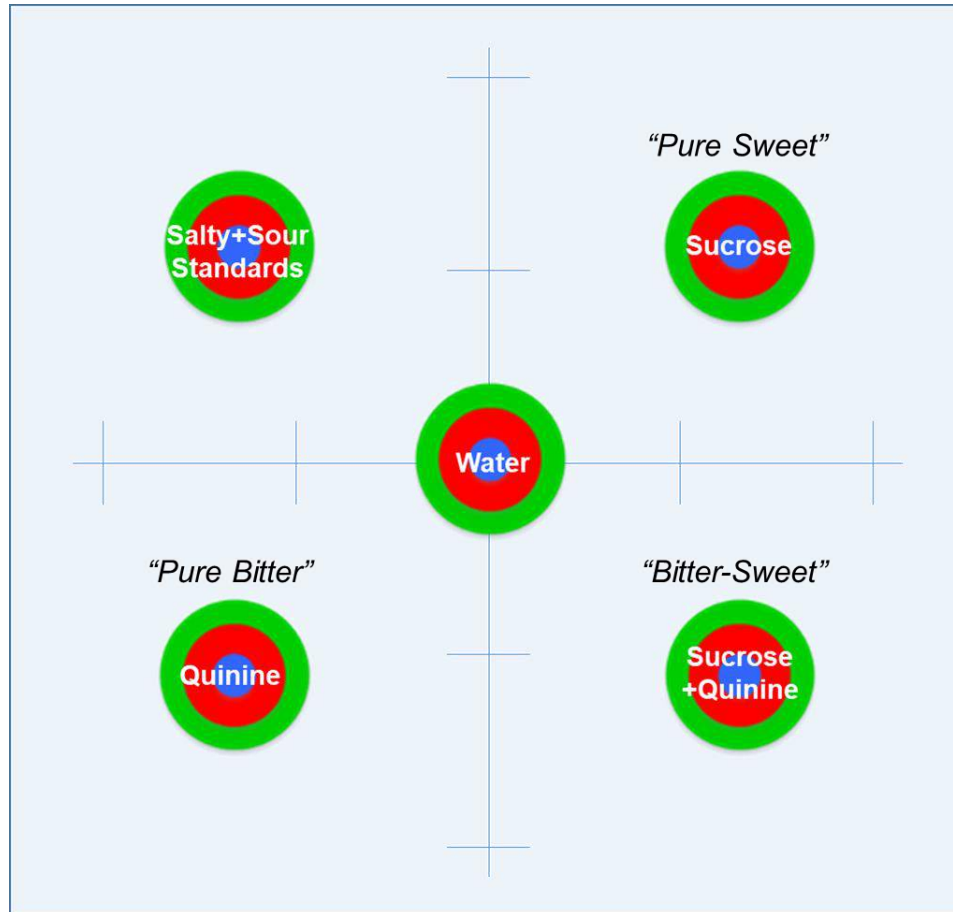
- Example of a ternary “Sucrose-like” vs. “Sweet-not Sucrose” vs “Not Sweet” test protocol
- Useful for screening sucrose/NNS blends



# How to Design a TāStation<sup>®</sup> Experiment

## *Create a Touch-screen Map*

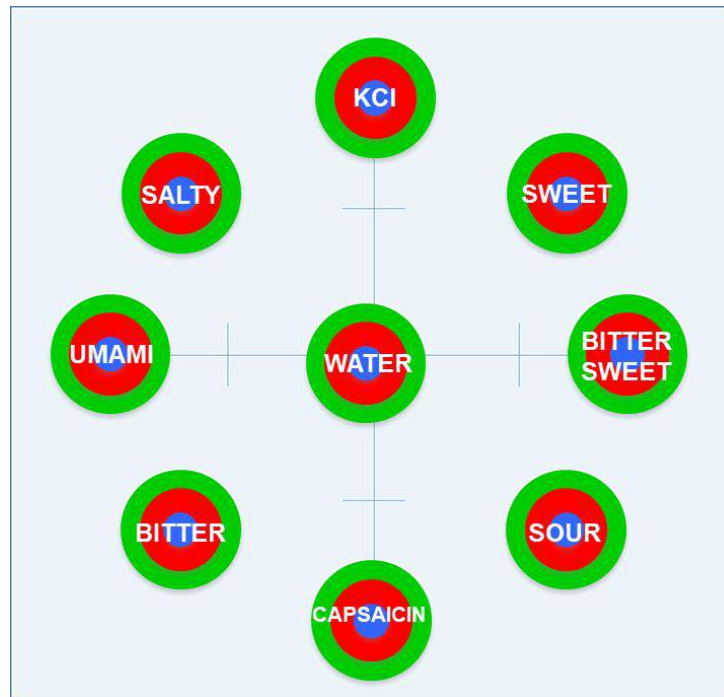
- Example of five-choice discrimination
- This protocol is useful for determining concentration-dependence of bitter off taste (and other off tastes) of non-nutritive sweeteners



# How to Design a TāStation<sup>®</sup> Experiment

## *Create a Touch-screen Map*

- Any number of targets can be programmed and trained
- Targets can be arranged in any pattern desired



# Programming the TāStation<sup>®</sup>

## *Extensive Experimental Design Options*

### **Input Variables at the Control of the Investigator**

- **Touch Screen Map**

- Definition of targets
- Regions within target
- Number of targets
- Location of targets

- **96-well plate**

- Contents for each well
- Definition of control or test article per well
- Which wells to test

- **Test variables**

- Training vs test
- Reward magnitude
  - Points per target region
- Penalty
  - Magnitude of point reduction
  - TO duration
- Number of trials
- Volume size per trial
- Intertrial interval

# How to Design a TāStation<sup>®</sup> Experiment

## *Programming a Touch-screen Map*

The screenshot displays the BIOMATED Microplate Editor software. The main window is titled "Control Definition Editor" and contains the following elements:

- Compounds List:** A table with columns "ID" and "Name".
- Control Definitions List:** A table with columns "ID" and "Name".
- Name and Description Fields:** Text input fields for "Name" (containing "Sweet") and "Description" (containing "Center Qi").
- Touch Grid:** A visual representation of a microplate well with a central target area.
- Values Table:** A table with columns "ID", "Type", "Radius", "Width", "Height", "X Pos", "Y Pos", "Pts", and "Color".
- Response Shape and Chip Color:** Dropdown menus for "Response Shape" (set to "Circle") and "Chip Color" (set to "Blue").
- X Coord, Y Coord, Points:** Input fields for "X Coord" (0.5), "Y Coord" (0.1), and "Points" (0).
- Circular Settings:** A "Radius" input field set to 0.
- Buttons:** "Delete", "Add", "Close", and "Save" buttons.

| ID   | Name       |
|------|------------|
| 1576 | 300 CF - C |
| 1568 | 300 CF - C |
| 1575 | 300 CF - C |
| 1574 | 300 CF - C |
| 1587 | 300 CF - T |
| 1588 | 300 CF - T |
| 1570 | 300 CF - v |
| 1355 | 300 mM S   |
| 1534 | 45 b-cycle |

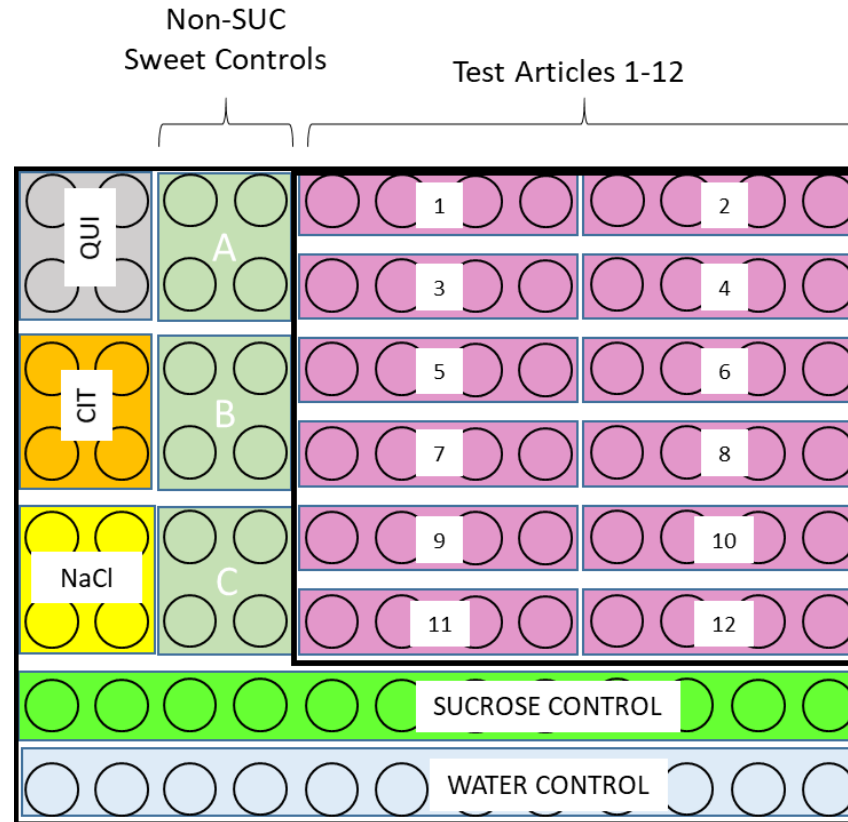
| ID   | Name       |
|------|------------|
| 1006 | Salty      |
| 1017 | SDT Non-S  |
| 1014 | SDT Plate  |
| 1013 | SDT Plate  |
| 1016 | SDT Sweet  |
| 1007 | Sour       |
| 1004 | Sweet      |
| 1015 | Vivek Test |
| 1003 | Water      |

| ID   | Type   | Radius | Width | Height | X Pos | Y Pos | Pts | Color |
|------|--------|--------|-------|--------|-------|-------|-----|-------|
| 1131 | Circle | 0.05   | 0     | 0      | 0.75  | 0.25  | 20  | BLUE  |
| 1130 | Circle | 0.1    | 0     | 0      | 0.75  | 0.25  | 10  | RED   |
| 1129 | Circle | 0.15   | 0     | 0      | 0.75  | 0.25  | 5   | GREEN |

- Input location, size, number of regions
- Input points per region
- Define the stimulus for the target

# How to Design a TāStation<sup>®</sup> Experiment

## *Design a Plate Layout*



- A likely plate configuration for 12 different sweetener blends (test articles)
- A, B, and C are non-nutritive sweeteners serving as non-sweet controls
- All other wells are non-sweet controls



# How to Design a TāStation<sup>®</sup> Experiment

## Program the 96-well Plate Contents

Plate Editor

**BIOMATED SOLUTIONS** Microplate Editor

Compounds \*Right Click Table to Add New Compound\*

| ID   | Name             | Description                             |
|------|------------------|---|
| 1378 | AITC             | Allyl isothiocyanate                    |
| 1340 | Alain            | Alain                                   |
| 1278 | Amberlite + NaOH | Amberlite IRP-64 + NaOH                 |
| 1277 | Amberlite IRP-64 | Amberlite IRP-64                        |
| 1109 | APAP             | 24 mg/ml                                |
| 1110 | APAP             | 12 mg/ml                                |
| 1399 | ASP + BB1        | Aspartame bitter blocker 1              |
| 1400 | ASP/High BB1     | high concentration of bb1 with aspartam |
| 1420 | ASP/High BB2     | high concentration of bb2 = aspartame   |

Control Definitions \*Right Click Table to Add/Edit Control Definition\*

| ID   | Name                         | Use State                             |
|------|------------------------------|---------------------------------------|
| 1006 | Salty                        | Center Q/I                            |
| 1017 | SDT Non-Sweet Max Reward     | SDT non-sweet circle with maximum rev |
| 1014 | SDT Plate 1 Non-sweet Circle | Non-sweet contols                     |
| 1013 | SDT Plate 1 Sweet Circle     | Target for all sweet stimuli          |
| 1016 | SDT Sweet Max Reward         | SDT sweet circle with maximum reward  |
| 1007 | Sour                         | Center Q/IV                           |
| 1004 | Sweet                        | Center Q/I                            |
| 1015 | Vivek Test 1                 | Test                                  |
| 1003 | Water                        | Center                                |

Concentration Units

0 mM

+ Add Test + Add Control - Remove

Apply To: Well

Close

MTP Assigner

1. Click “Add Test” for test article, “Add Control” for control standard
2. Select compound from menu then click designated well; enter concentration
  - Compounds can be entered into single wells or entire columns or rows
3. Click “Control Definitions” to associate target locations and definitions (previously defined in a different menu) with control standard wells

# How to Design a TāStation<sup>®</sup> Experiment

## *Designate a Test Plate ID for a Specific Test*

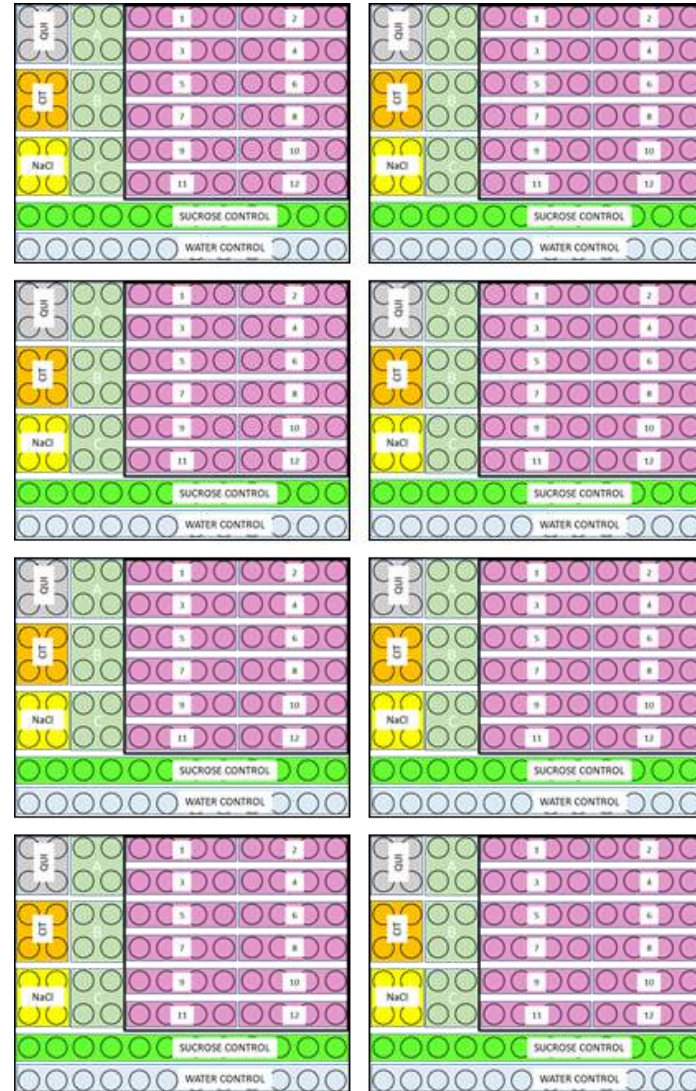
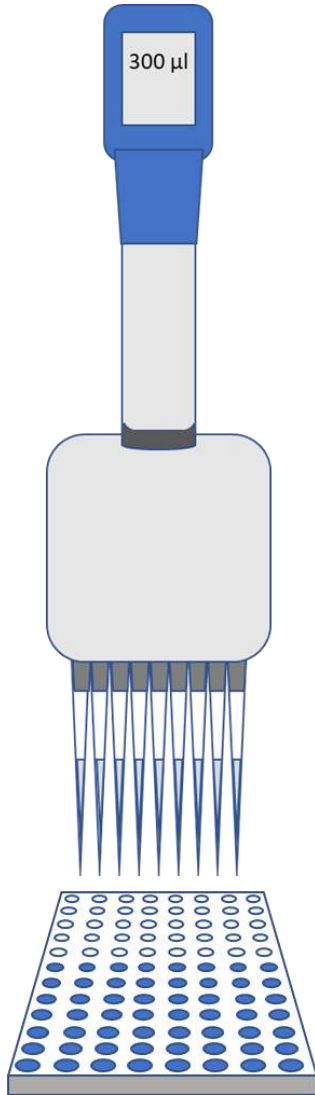
The screenshot displays the TaStation Administration Console interface. The main window shows a 'Plates' table with columns for ID, Name, and Description. The row with ID 1118, 'Sucrose Threshold 2', is highlighted. A 'Create Plate' dialog box is open, showing the 'Actual Plate Creation' form. The form includes fields for Name (st2), Description, and a 'Training?' checkbox. The Client is set to 'Opertech Bio' and the Project is 'Sucrose Threshold'. The dialog also has 'Save' and 'Cancel' buttons. In the background, a table shows the 'Time Created', 'Plate ID', and 'Exp ID' for various tests.

| Time Created           | Plate ID | Exp ID |
|------------------------|----------|--------|
| 12/3/2019 1:29:20 PM   | 1115     | 1001   |
| 12/3/2019 11:42:44 AM  | 1115     | 1001   |
| 12/3/2019 11:39:58 AM  | 1125     | 1001   |
| 11/26/2019 10:56:58 AM | 1124     | 1001   |
| 11/26/2019 10:03:01 AM | 1067     | 1001   |
| 11/26/2019 10:02:48 AM | 1118     | 1001   |
| 11/26/2019 10:02:36 AM | 1115     | 1001   |
| 11/26/2019 10:01:54 AM | 1118     | 1001   |
| 11/26/2019 10:01:45 AM | 1118     | 1001   |
| 11/24/2019 10:57:44 AM | 1118     | 1001   |
| 11/24/2019 10:57:35 AM | 1115     | 1001   |
| 11/24/2019 10:57:11 AM | 1118     | 1001   |
| 11/24/2019 10:56:56 AM | 1118     | 1001   |
| 11/22/2019 12:42:00 PM | 1118     | 1001   |
| 11/22/2019 12:41:52 PM | 1118     | 1001   |
| 11/22/2019 12:41:44 PM | 1118     | 1001   |
| 11/22/2019 12:08:30 PM | 1115     | 1001   |
| 11/22/2019 12:08:22 PM | 1115     | 1001   |
| 11/22/2019 11:48:30 AM | 1124     | 1001   |
| 11/22/2019 10:31:37 AM | 1067     | 1001   |
| 11/22/2019 10:10:52 AM | 1115     | 1001   |
| 11/21/2019 3:04:36 PM  | 1118     | 1001   |
| 11/21/2019 3:01:29 PM  | 1118     | 1001   |
| 11/21/2019 2:59:19 PM  | 1118     | 1001   |
| 11/21/2019 2:04:18 PM  | 1115     | 1001   |
| 11/21/2019 2:01:48 PM  | 1115     | 1001   |

1. Once created, each plate design is permanently assigned an ID number and is stored in the database
2. For any given test, each subject will be given his/her own copy of the actual test plate
  - Each individual actual plate is given a unique name and ID number, which are stored in the database

# Make the Plates for a Test

*Trained Technician, 8-channel Electronic Pipette, 8 Plates ~30 min*





# How to Design a TāStation<sup>®</sup> Experiment

## Define Test Parameters

The screenshot displays the BIOMATED SOLUTIONS TaStation Administration Console. The 'Plates' menu is open, showing a list of plate designs with columns for ID, Name, and Description. The 'Experiment Def' menu is also open, showing a list of pre-defined experimental definitions. The 'Experimental Definition Editor' dialog box is open, allowing for the configuration of experimental parameters.

**Plates**

| ID   | Name                         | Description                           |
|------|------------------------------|---------------------------------------|
| 1125 | Test                         |                                       |
| 1124 | Lactisole Test               | Lactisole, saccharin, sucrose         |
| 1123 | #7 TEST                      | Ingredients #73-84                    |
| 1122 | Training 3                   | training 2 + cyclamate                |
| 1121 | Diphenhydramine Sweeteners   | Screen of D and sweeteners            |
| 1120 | Diphenhydramine Screen       | D + [redacted] pounds                 |
| 1119 | Diphenhydramine CR + b-cyclo | b-cyclodextrin + diphenhydramine      |
| 1118 | Sucrose Threshold 2          | Sucrose CR                            |
| 1117 | #6 UPDATED                   | [redacted] 0247                       |
| 1116 | #6 Test Plate                | Ingredients #61-72                    |
| 1115 | Sucrose Threshold 1          | threshold testing                     |
| 1114 | Test 1                       | citric buffer, reb a, sucrose         |
| 1113 | Discrimination 5             | 3-way, test training                  |
| 1112 | 4 retest                     | 6 ingredients from [redacted]         |
| 1111 | tech Test Plate 1            | [redacted] compounds 2/5 with chicken |

**Experiment Def**

| ID   | Name                | Description |
|------|---------------------|-------------|
| 1001 | Full Feature        | Test        |
| 1002 | Partial Feature     | Test 2      |
| 1003 | Random Penalty Test |             |

**Experimental Definition Editor**

Name: Full Feature

Description: Test

Penalty Type: Points + Delay

Points: 10

Delay (s): 15

Reward Type: Maximum

Min Reward: 5

Max Reward: 20

Number of Trials: 96

Sequential Wells? [checked]

Image File: Grid.png

Random Penalties: 0

1. Select a plate design (created in previous slide) from the “Plates” menu. Each plate design has an ID number in the database
2. Select a pre-defined set of parameters from the “Experiment Def” menu
3. Change any parameter variables to fine-tune the experimental design for the immediate purposes of the test using the “Experimental Definition Editor”

# How to Design a TāStation<sup>®</sup> Experiment

*Log in the subject, Enter the Designated Test Plate ID and Click Run!*

TaStation Server



Edit Project List

Analyze Data

Plates \*Right Click to Sort\*

| ID   | Name                         | Description                      |
|------|------------------------------|----------------------------------|
| 1125 | Test                         |                                  |
| 1124 | Lactisole Test               | Lactisole, saccharin, sucrose    |
| 1123 | #7 TEST                      | Ingredients #73-84               |
| 1122 | Training 3                   | training 2 + cyclamate           |
| 1121 | Diphenhydramine Sweeteners   | Screen of D and sweeteners       |
| 1120 | Diphenhydramine Screen       | D + bounds                       |
| 1119 | Diphenhydramine CR + b-cyclo | b-cyclodextrin + diphenhydramine |
| 1118 | Sucrose Threshold 2          | Sucrose CR                       |
| 1117 | #6 UPDATED                   | 0247                             |
| 1116 | #6 Test Plate                | Ingredients #61-72               |
| 1115 | Sucrose Threshold 1          | threshold testing                |
| 1114 | Test 1                       | citric buffer, reb a, sucrose    |
| 1113 | Discrimination 5             | 3-way, test training             |
| 1112 | 4 retest                     | 6 ingredients from               |
| 1111 | tech Test Plate 1            | compounds 2/5 with chicken       |

+ Add
- Remove
📄 Editor (V2)
📄 Editor

Experiment Def

| ID   | Name                | Description |
|------|---------------------|-------------|
| 1001 | Full Feature        | Test        |
| 1002 | Partial Feature     | Test 2      |
| 1003 | Random Penalty Test |             |

+ Add
📄 Edit

Actual Plates

| ID   | Name                 | Description | Time Created           | Plate ID | Exp ID |
|------|----------------------|-------------|------------------------|----------|--------|
| 5844 | Demo                 | Demo        | 12/3/2019 1:29:20 PM   | 1115     | 1001   |
| 5843 | Demo                 | Demo        | 12/3/2019 11:42:44 AM  | 1115     | 1001   |
| 5839 | dfdfg                |             | 12/3/2019 11:39:58 AM  | 1125     | 1001   |
| 5787 | Lactisole Test       |             | 11/26/2019 10:56:58 AM | 1124     | 1001   |
| 5786 | bittersweet training |             | 11/26/2019 10:03:01 AM | 1067     | 1001   |
| 5785 | st2                  |             | 11/26/2019 10:02:48 AM | 1118     | 1001   |
| 5784 | st1                  |             | 11/26/2019 10:02:36 AM | 1115     | 1001   |
| 5783 | ST2                  |             | 11/26/2019 10:01:54 AM | 1118     | 1001   |
| 5782 | ST2                  |             | 11/26/2019 10:01:45 AM | 1118     | 1001   |
| 5781 | st2                  |             | 11/24/2019 10:57:44 AM | 1118     | 1001   |
| 5780 | st1                  |             | 11/24/2019 10:57:35 AM | 1115     | 1001   |
| 5779 | st2                  |             | 11/24/2019 10:57:11 AM | 1118     | 1001   |
| 5778 | ST2                  |             | 11/24/2019 10:56:56 AM | 1118     | 1001   |
| 5777 | st2                  |             | 11/22/2019 12:42:00 PM | 1118     | 1001   |
| 5776 | st2                  |             | 11/22/2019 12:41:52 PM | 1118     | 1001   |
| 5775 | ST2                  |             | 11/22/2019 12:41:44 PM | 1118     | 1001   |
| 5774 | ST1                  |             | 11/22/2019 12:08:30 PM | 1115     | 1001   |
| 5773 | ST1                  |             | 11/22/2019 12:08:22 PM | 1115     | 1001   |
| 5772 | Lactisole Test       |             | 11/22/2019 11:48:30 AM | 1124     | 1001   |
| 5771 | Bittersweet Training |             | 11/22/2019 10:31:37 AM | 1067     | 1001   |
| 5770 | ST1                  |             | 11/22/2019 10:10:52 AM | 1115     | 1001   |
| 5769 | ST2                  |             | 11/21/2019 3:04:36 PM  | 1118     | 1001   |
| 5768 | ST2                  |             | 11/21/2019 3:01:29 PM  | 1118     | 1001   |
| 5767 | ST2                  |             | 11/21/2019 2:59:19 PM  | 1118     | 1001   |
| 5766 | ST1                  |             | 11/21/2019 2:04:18 PM  | 1115     | 1001   |
| 5765 | ST1                  |             | 11/21/2019 2:01:48 PM  | 1115     | 1001   |

📄 Create Plate
✖ Close

# Data Quality Assurance

## Permanent Record of All Recorded Data on Cloud-based Secure Server

| Session | Plate ID | Plate Name | Plate Desc | First Name | Last Name | Start Time | End Time |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 5768 | 5844 | Demo | Demo | Kyle | Palmer | 12/3/2019 1:32:55 PM |  |
| 5767 | 5784 | st1 |  |  |  | 11/26/2019 11:15:24 AM | 11/26/2019 11:15:27 AM |
| 5766 | 5785 | st2 |  |  |  | 11/26/2019 11:06:49 AM | 11/26/2019 11:50:10 AM |
| 5765 | 5787 | Lactisole Test |  |  |  | 11/26/2019 10:58:02 AM | 11/26/2019 11:38:19 AM |
| 5764 | 5783 | ST2 |  |  |  | 11/26/2019 10:46:37 AM | 11/26/2019 11:28:48 AM |
| 5763 | 5786 | bittersweert training |  |  |  | 11/26/2019 10:15:52 AM | 11/26/2019 10:56:04 AM |
| 5762 | 5784 | st1 |  |  |  | 11/26/2019 10:14:17 AM | 11/26/2019 11:05:32 AM |
| 5761 | 5782 | ST2 |  |  |  | 11/26/2019 10:05:30 AM | 10:44:54 AM |
| 5760 | 5781 | st2 |  |  |  | 11/24/2019 12:09:51 PM | 11/24/2019 12:55:08 PM |
| 5759 | 5780 | st1 |  |  |  | 11/24/2019 11:19:47 AM | 12:07:50 PM |
| 5758 | 5779 | st2 |  |  |  | 11/24/2019 11:09:04 AM | 12:07:55 PM |

**Session Data**

| First Name             | Last Name              | Email Address  | Age      | User ID |
|------------------------|------------------------|----------------|----------|---------|
|                        |                        |                |          | 1039    |
| Smoker                 | Gender                 | Ethnicity      | ZIP Code |         |
| No                     | Female                 | Asian          |          |         |
| Experiment             | Experiment Description |                |          |         |
| Full Feature           | Test                   |                |          |         |
| Penalty Type           | Penalty Time (s)       | Penalty Points |          |         |
| Point & Doty           | 15                     | 10             |          |         |
| Image                  |                        |                |          |         |
| Grid.png               |                        |                |          |         |
| Start Time             | End Time               |                |          |         |
| 11/26/2019 11:06:49 AM | 11/26/2019 11:50:10 AM |                |          |         |

**Test Wells**

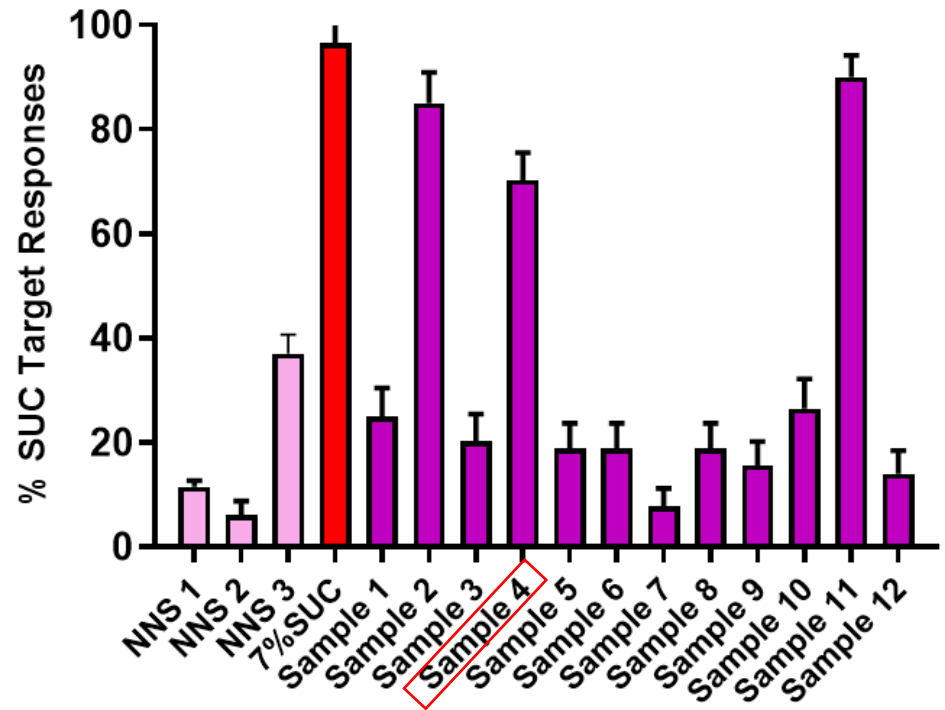
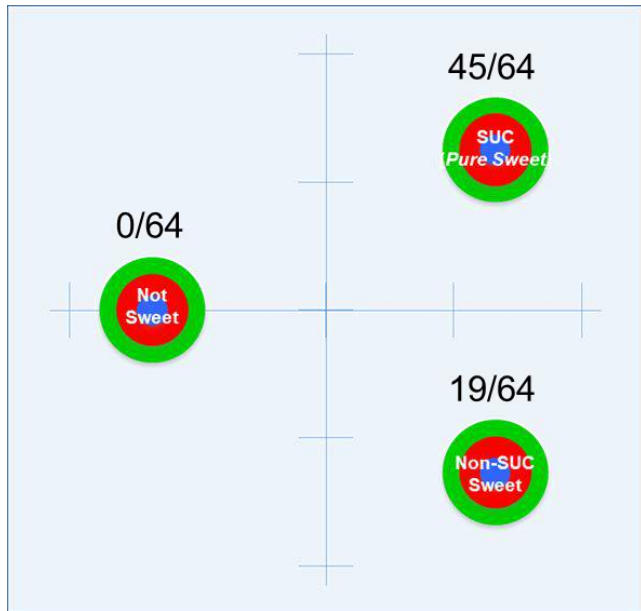
| Well | Name    | Description | User | X    | Y    | Tech Time   | Pts | Order |
|------|---------|-------------|------|------|------|-------------|-----|-------|
| A1   | Sucrose |             |      | 0.70 | 0.43 | 11:19:36 AM | 20  | 15    |
| A2   | Sucrose |             |      | 0.70 | 0.51 | 11:17:47 AM | 20  | 71    |
| A3   | Sucrose |             |      | 0.74 | 0.52 | 11:02:17 AM | 20  | 37    |
| A4   | Sucrose |             |      | 0.75 | 0.50 | 11:05:16 AM | 20  | 44    |
| A5   | Sucrose |             |      | 0.74 | 0.51 | 10:52:27 AM | 20  | 14    |
| A6   | Sucrose |             |      | 0.70 | 0.50 | 11:27:56 AM | 20  | 54    |
| B1   | Sucrose |             |      | 0.72 | 0.51 | 10:47:38 AM | 20  | 3     |
| B2   | Sucrose |             |      | 0.74 | 0.50 | 11:28:45 AM | 20  | 36    |
| B3   | Sucrose |             |      | 0.72 | 0.50 | 11:24:19 AM | 20  | 86    |
| B4   | Sucrose |             |      | 0.74 | 0.50 | 10:53:38 AM | 20  | 17    |
| B5   | Sucrose |             |      | 0.71 | 0.50 | 11:07:04 AM | 20  | 48    |
| B6   | Sucrose |             |      | 0.74 | 0.50 | 11:16:59 AM | 20  | 58    |
| C1   | Sucrose |             |      | 0.74 | 0.50 | 11:09:28 AM | 20  | 52    |
| C2   | Sucrose |             |      | 0.70 | 0.50 | 10:48:48 AM | 20  | 6     |
| C3   | Sucrose |             |      | 0.74 | 0.43 | 10:51:59 AM | 20  | 13    |
| C4   | Sucrose |             |      | 0.75 | 0.50 | 10:54:02 AM | 20  | 18    |
| C5   | Sucrose |             |      | 0.75 | 0.43 | 10:46:53 AM | 20  | 1     |
| C6   | Sucrose |             |      | 0.74 | 0.50 | 10:49:39 AM | 20  | 8     |
| D1   | Sucrose |             |      | 0.74 | 0.52 | 11:26:42 AM | 20  | 91    |
| D2   | Sucrose |             |      | 0.70 | 0.50 | 10:59:00 AM | 20  | 29    |
| D3   | Sucrose |             |      | 0.70 | 0.51 | 11:14:57 AM | 20  | 64    |
| D4   | Sucrose |             |      | 0.70 | 0.50 | 10:56:48 AM | 20  | 24    |
| D5   | Sucrose |             |      | 0.72 | 0.50 | 11:20:31 AM | 20  | 77    |
| D6   | Sucrose |             |      | 0.70 | 0.51 | 11:12:55 AM | 20  | 59    |
| E1   | Sucrose |             |      | 0.74 | 0.50 | 10:59:24 AM | 20  | 30    |
| E2   | Sucrose |             |      | 0.27 | 0.50 | 11:20:11 AM | 20  | 83    |
| E3   | Sucrose |             |      | 0.70 | 0.50 | 11:03:56 AM | 20  | 53    |
| E4   | Sucrose |             |      | 0.70 | 0.50 | 11:21:21 AM | 20  | 79    |
| E5   | Sucrose |             |      | 0.74 | 0.50 | 11:16:33 AM | 20  | 68    |
| E6   | Sucrose |             |      | 0.70 | 0.50 | 10:56:22 AM | 20  | 23    |

1. Login to the database from any location with internet service
2. Select a specific test by the "Session" number
3. Download the data as an Excel file
4. Datasets also can be analyzed through a MatLab module integrated into the TāSatation<sup>®</sup> software



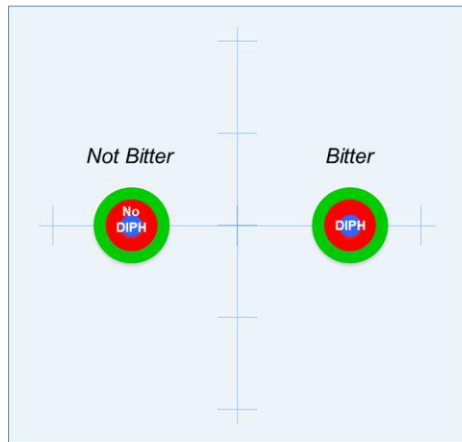
# The Frequency of Responses are Recorded *Plotted as Proportion of Target-of-Interest Responses*

Response frequencies  
on trials of Sample 4

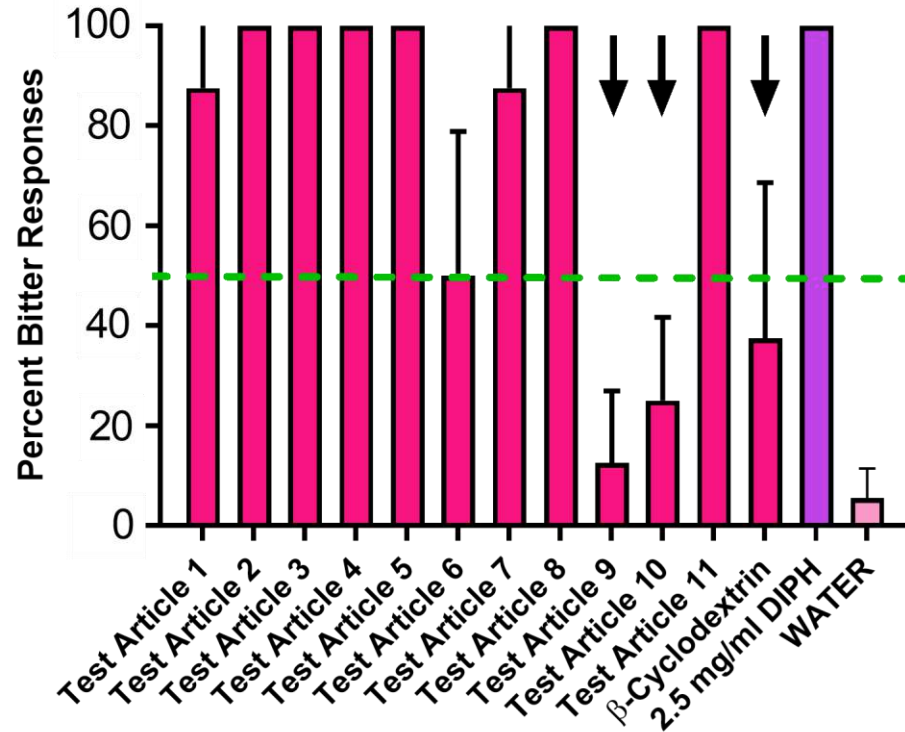


Ternary test of “Sucrose-like” vs “Non-sucrose sweet” vs “Not sweet”

# Rapid Screening of Bitter Blockers with TāStation<sup>®</sup>

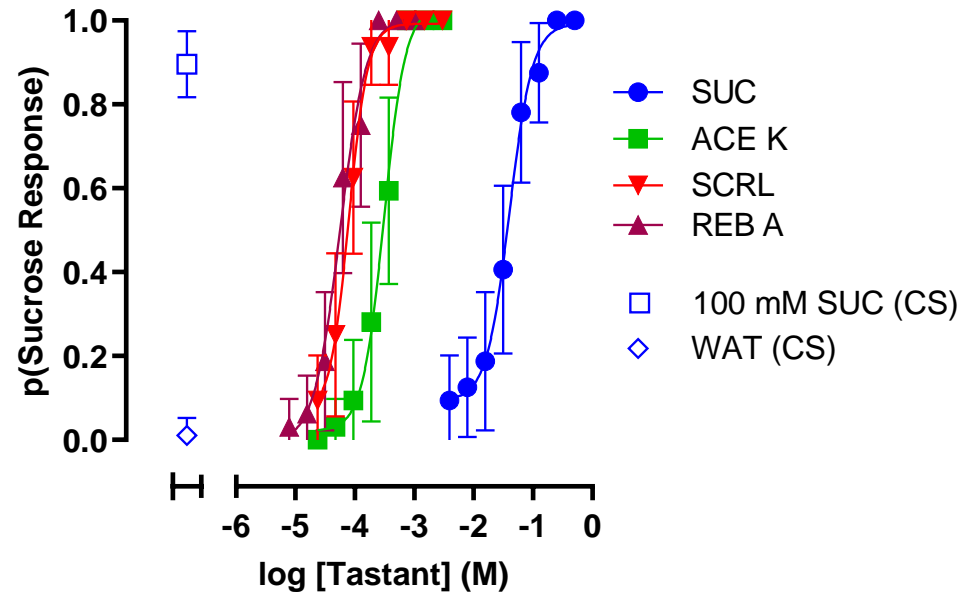
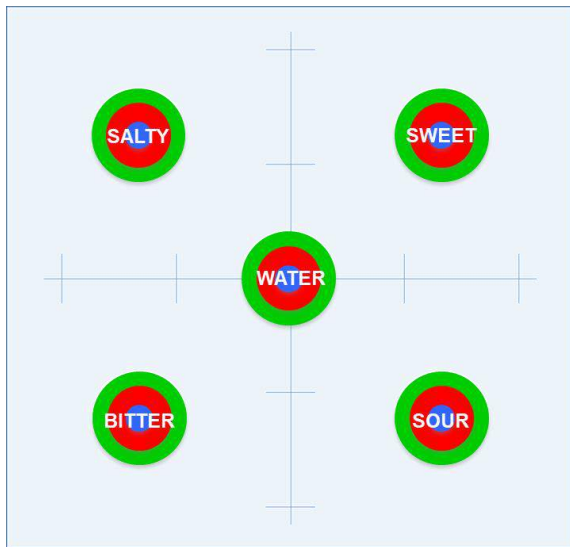


Diphenhydramine Plus Putative Bitter Blockers  
*N = 2 Subjects, 2 Tests Each*



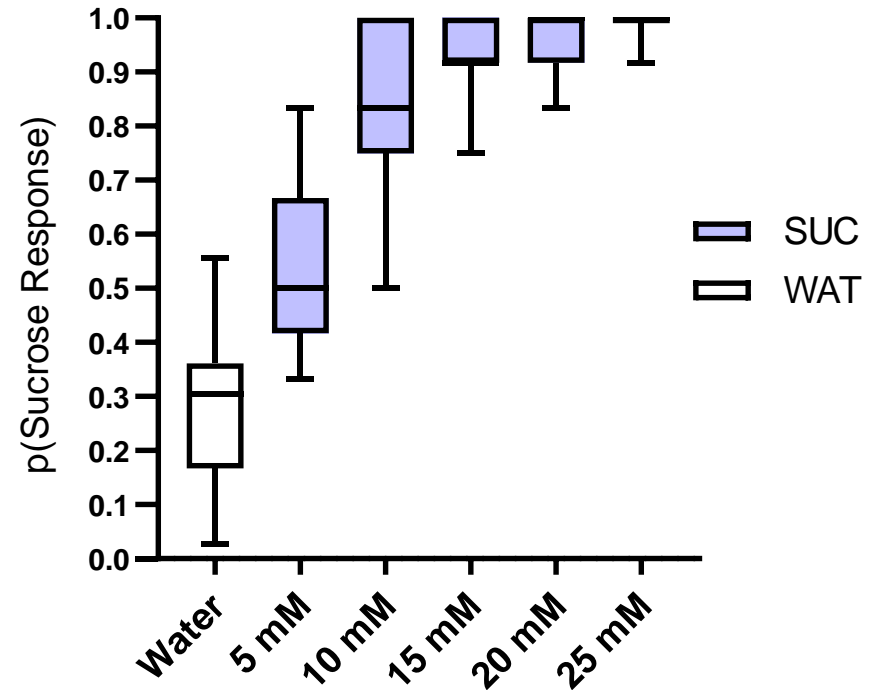
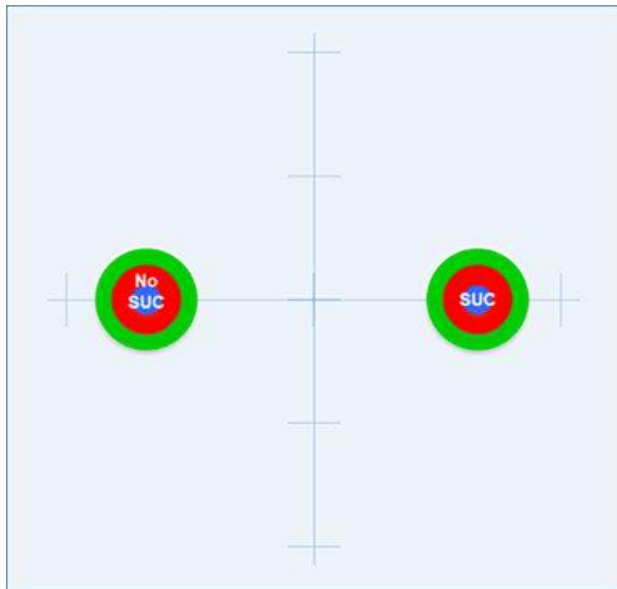
- Phase 2 of bitterness mitigation: Putative bitter blockers are mixed with diphenhydramine and compared to diphenhydramine alone (“Bitter” target) in a binary “bitter vs. non-bitter” procedure
- Dashed green line indicates arbitrary cut-off for “hit” selection; black arrows indicate “hits”
- Hits are advanced to Phase 3 for optimization of bitter-blocking efficacy

# Concentration-response Analysis



- Four sweeteners evaluated in single plate, 8 subjects, each tested twice
- Also capable of quantifying concentration-dependence of off-tastes
- Also capable of characterizing individual concentration-response functions for each subject

# Threshold Determinations by Signal Detection



- Method of Constant Stimuli
- Results are from 14 subjects, each tested twice
- Also capable of quantifying thresholds for individual subjects

# *Established Opertech Capabilities*

## – Flavor Ingredients, Food and Bev

- **Sweeteners**
  - Discovery of natural product sweeteners and enhancers
  - Blocking bitter off-tastes
  - Rapid evaluation of sweetener blends
  - Concentration-dependence of taste qualities
- **Sodium reduction strategies**
- **Bitter Blocking**
- **Formulation optimization**
  - Rapid screening and prioritization for best tasting formulations
  - Combinatorial strategy for testing of ingredient mixtures

## – Pharma

- **Active Pharmaceutical Ingredients**
  - Taste characterization
  - Bitterness mitigation
- **Sour mitigation**
- **Fast formulation development**

# TāStation<sup>®</sup> Flexible Business Models

Achieve optimal arrangement for client's objective

## Fee for service

- Taste evaluation of new tastants, enhancers, blockers, and formulations
- TāStation<sup>®</sup> is portable
  - Client provides samples for testing at Opertech
  - Opertech brings TāStation<sup>®</sup> to client for testing at their location
- Opertech provides detail results (data) package

## TāStation<sup>®</sup> licensing

- Apparatus and software
- Non-exclusive annual site license
  - Fee based on number of TāStation<sup>®</sup> units
- Includes implementation and training
- Access to help desk, updates and system maintenance
- Additional consulting available
  - Guidance on experimental design
  - Guidance on data analysis and interpretation of results





**Thank You.**

Scott Horvitz, CEO

R. Kyle Palmer, PhD, CSO

Opertech Bio, Inc.

Pennovation Center Bldg. 450

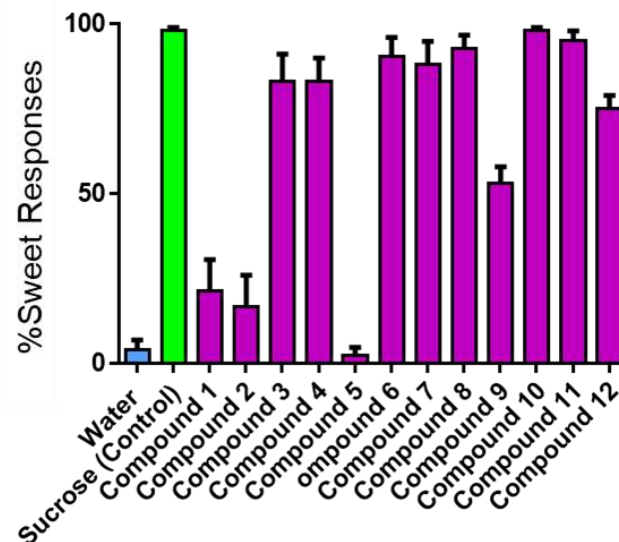
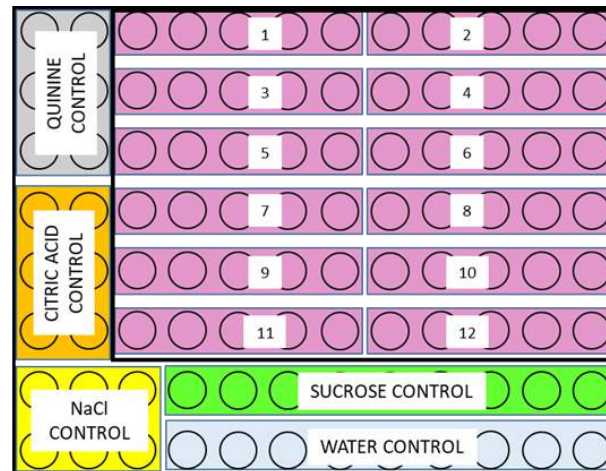
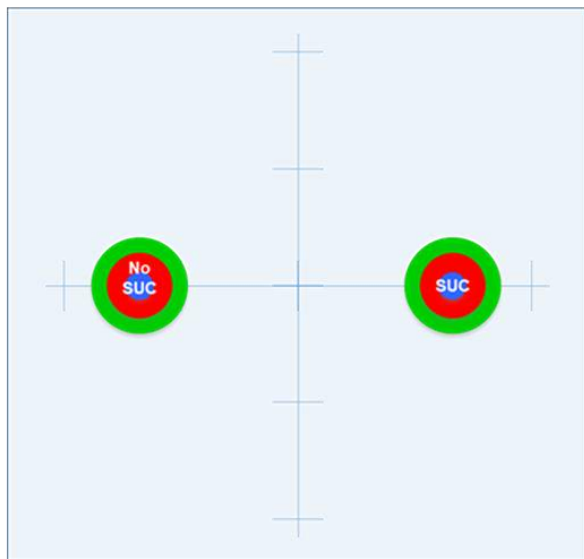
3401 Grays Ferry Avenue

Philadelphia, PA 19146

Phone: 267-534-3248

# Rapid Throughput Screening for Taste Active Substances

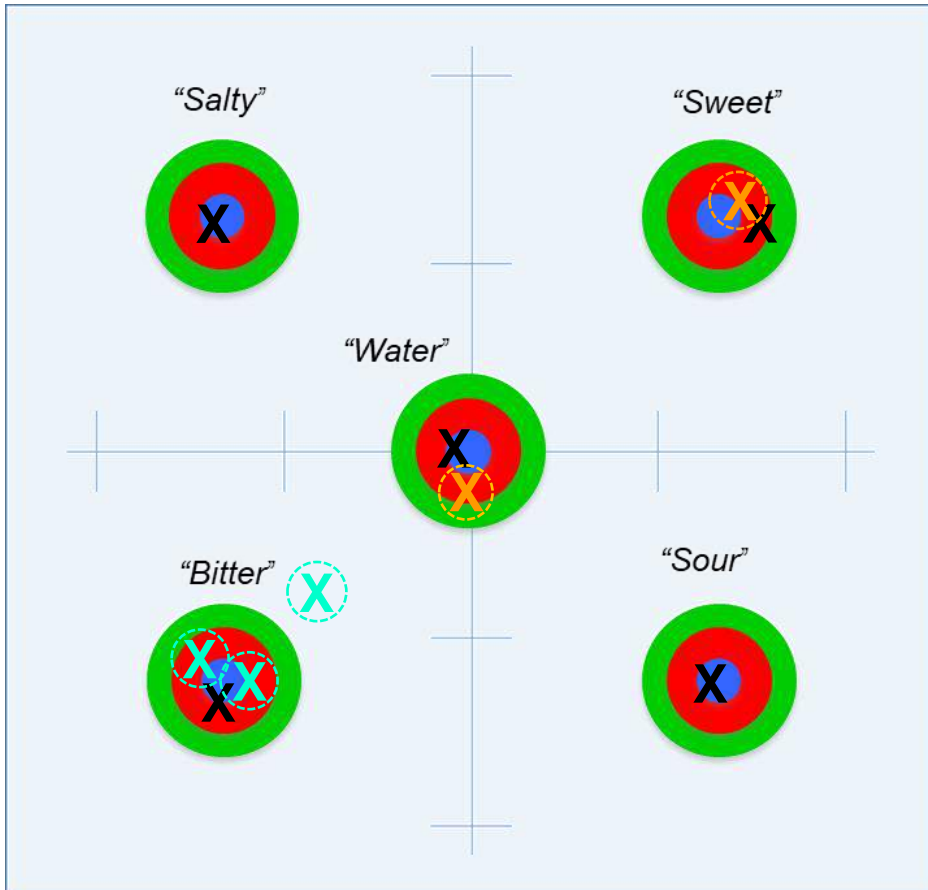
## Simple “Sweet vs. Not Sweet”



- The task is a simple binary discrimination of “Sweet” (sucrose) vs. “Non-sweet” (non-sweet taste stimuli, water)
  - Frequently used for screens of natural product collections for sweet taste activity
- The schematic 96-well plate shows a design for screening 12 natural products, each replicated in 5 wells, tested at single concentrations (the rest of the wells are control standards)
  - Typically, each of 8 subjects would test this plate twice, for a complete dataset consisting of 80 data points for each natural product
- The graph shows a hypothetical dataset resulting from this type of experiment, with data plotted as the percentage of responses that occurred on the sweet target on trials of each of the listed natural products, sucrose, and water
  - Compounds 3,4, 6, 7, 10 and 11 are “hits”

# Recording a Subject's Responses: An Illustration

*Targets are Invisible to Subject*



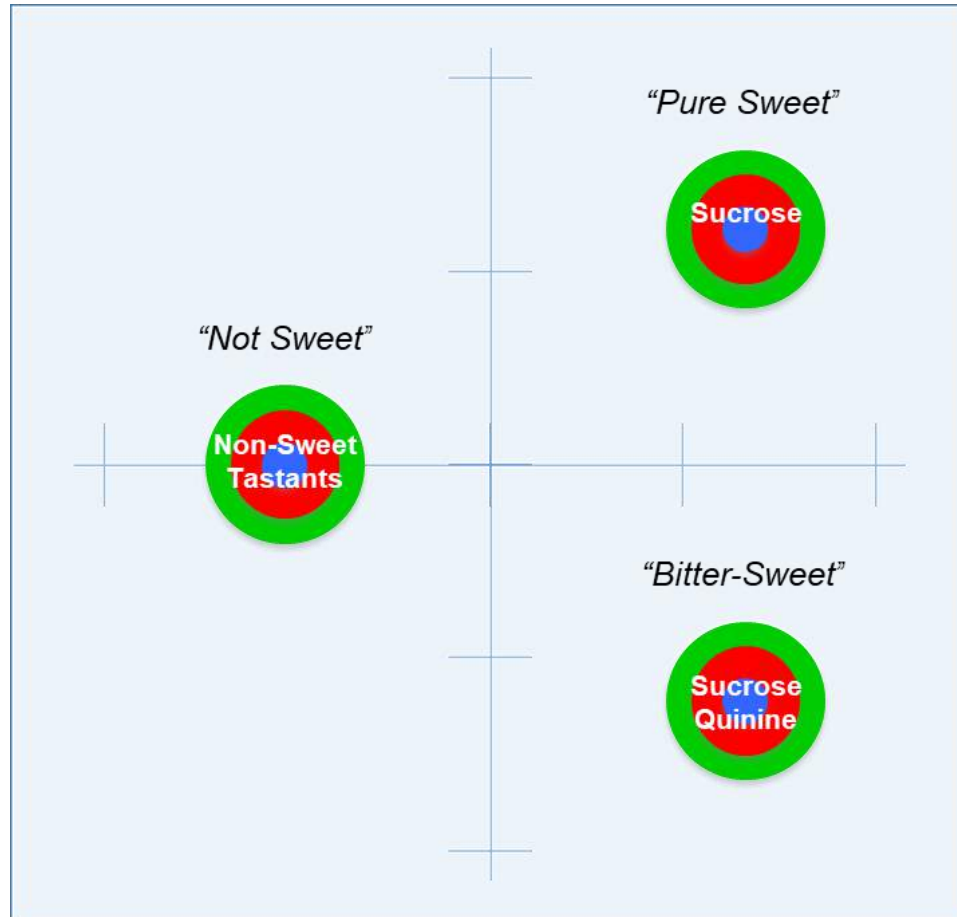
## Order of Trials

1. Control (sucrose)-Correct (reward)
2. Control (quinine)-Correct (reward)
3. Test Article-Reward
4. Control (quinine)-Error (penalty)
5. Test Article-Reward
6. Test Article-Reward
7. Control (water)-Correct (reward)
8. Control (water)-Error (penalty)
9. Control (NaCl)-Correct (reward)
10. Control (citric acid)-Correct (reward)

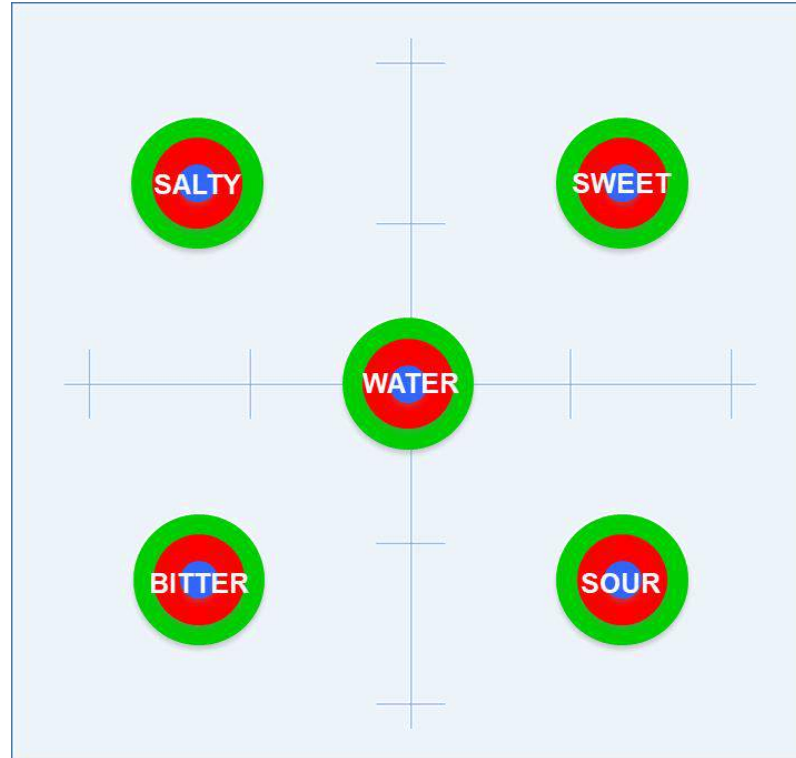
# How to Design a TāStation<sup>®</sup> Experiment

## *Create a Touch-screen Map*

- Example of a ternary “Pure Sweet” vs “Bitter-sweet” vs “Not Sweet” test protocol
- Useful for rapidly screening natural products for the best sucrose-like taste
  - A more nuanced approach to natural product sweetener discovery using focused libraries



# The Frequency of Responses are Recorded *Plotted as Proportion of Target-appropriate Responses*



- In this example, the datum is the distance of the subject's response to the bullseye coordinates of the "Bitter" target
- The same response coordinates could be recalculated as the distance relative to any of the other targets for additional analyses

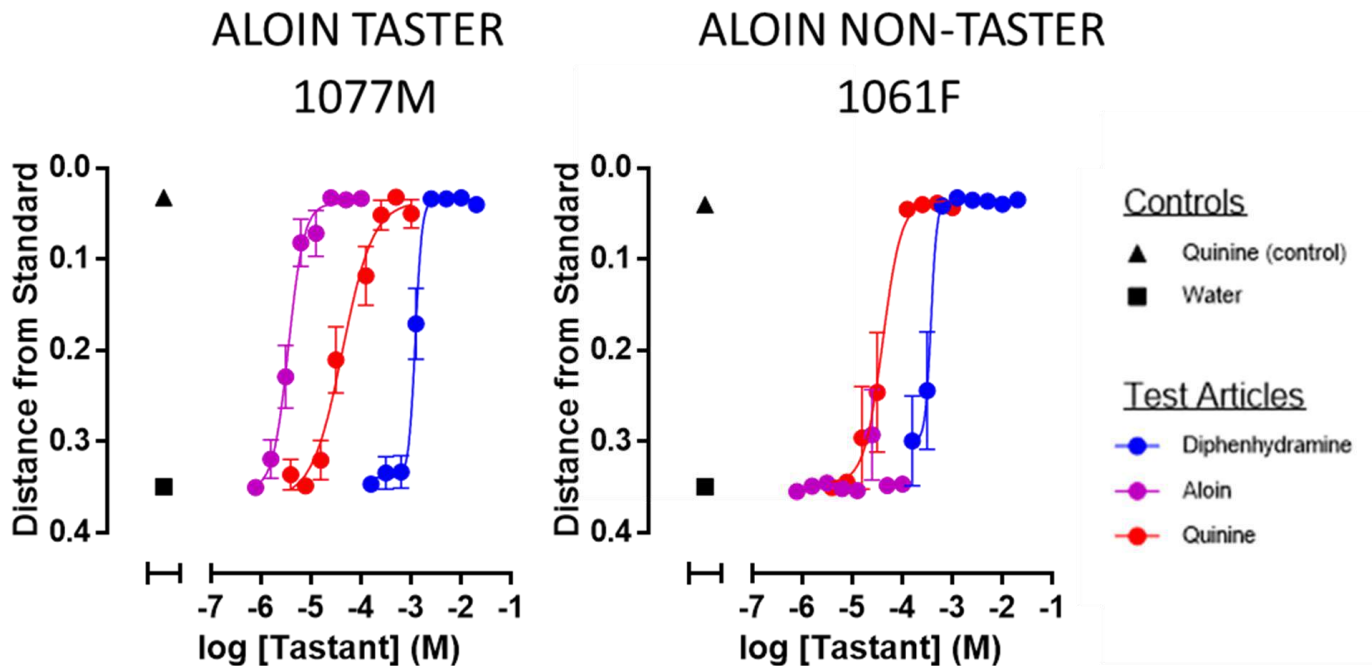
# Data Quality Assurance

## Analyzing the Data

| Well | Name    | [sucrose] (log M) | X        | Y        | Ideal X | Ideal Y | x2-x1    | y2-y1    | distance | MEAN            | SEM             | Touch Time | Pts | Order |
|------|---------|-------------------|----------|----------|---------|---------|----------|----------|----------|-----------------|-----------------|------------|-----|-------|
| A1   | Sucrose | -0.301029996      | 0.714785 | 0.502475 | 0.75    | 0.5     | 0.035215 | -0.00248 | 0.035302 |                 |                 | 43795.43   | 20  | 38    |
| A2   | Sucrose | -0.301029996      | 0.735739 | 0.534653 | 0.75    | 0.5     | 0.014261 | -0.03465 | 0.037473 |                 |                 | 43795.44   | 20  | 69    |
| A3   | Sucrose | -0.301029996      | 0.734575 | 0.512376 | 0.75    | 0.5     | 0.015425 | -0.01238 | 0.019776 |                 |                 | 43795.44   | 20  | 71    |
| A4   | Sucrose | -0.301029996      | 0.74156  | 0.507426 | 0.75    | 0.5     | 0.00844  | -0.00743 | 0.011242 |                 |                 | 43795.44   | 20  | 64    |
| A5   | Sucrose | -0.301029996      | 0.722934 | 0.501238 | 0.75    | 0.5     | 0.027066 | -0.00124 | 0.027094 |                 |                 | 43795.43   | 20  | 40    |
| A6   | Sucrose | -0.301029996      | 0.74156  | 0.498762 | 0.75    | 0.5     | 0.00844  | 0.001238 | 0.00853  | <b>0.023236</b> | <b>0.005423</b> | 43795.43   | 20  | 51    |
| B1   | Sucrose | -0.602059991      | 0.738068 | 0.502475 | 0.75    | 0.5     | 0.011932 | -0.00248 | 0.012186 |                 |                 | 43795.43   | 20  | 44    |
| B2   | Sucrose | -0.602059991      | 0.721769 | 0.507426 | 0.75    | 0.5     | 0.028231 | -0.00743 | 0.029191 |                 |                 | 43795.42   | 20  | 14    |
| B3   | Sucrose | -0.602059991      | 0.743888 | 0.497525 | 0.75    | 0.5     | 0.006112 | 0.002475 | 0.006594 |                 |                 | 43795.43   | 20  | 30    |
| B4   | Sucrose | -0.602059991      | 0.748545 | 0.5      | 0.75    | 0.5     | 0.001455 | 0        | 0.001455 |                 |                 | 43795.43   | 20  | 36    |
| B5   | Sucrose | -0.602059991      | 0.742724 | 0.5      | 0.75    | 0.5     | 0.007276 | 0        | 0.007276 |                 |                 | 43795.45   | 20  | 96    |
| B6   | Sucrose | -0.602059991      | 0.74156  | 0.502475 | 0.75    | 0.5     | 0.00844  | -0.00248 | 0.008795 | <b>0.010916</b> | <b>0.004297</b> | 43795.42   | 20  | 7     |
| C1   | Sucrose | -0.903089987      | 0.733411 | 0.514851 | 0.75    | 0.5     | 0.016589 | -0.01485 | 0.022265 |                 |                 | 43795.44   | 20  | 59    |
| C2   | Sucrose | -0.903089987      | 0.746217 | 0.497525 | 0.75    | 0.5     | 0.003783 | 0.002475 | 0.004521 |                 |                 | 43795.43   | 20  | 29    |
| C3   | Sucrose | -0.903089987      | 0.732247 | 0.50495  | 0.75    | 0.5     | 0.017753 | -0.00495 | 0.01843  |                 |                 | 43795.44   | 20  | 54    |
| C4   | Sucrose | -0.903089987      | 0.735739 | 0.5      | 0.75    | 0.5     | 0.014261 | 0        | 0.014261 |                 |                 | 43795.44   | 20  | 81    |
| C5   | Sucrose | -0.903089987      | 0.748545 | 0.498762 | 0.75    | 0.5     | 0.001455 | 0.001238 | 0.00191  |                 |                 | 43795.44   | 20  | 61    |
| C6   | Sucrose | -0.903089987      | 0.735739 | 0.502475 | 0.75    | 0.5     | 0.014261 | -0.00248 | 0.014474 | <b>0.012644</b> | <b>0.00354</b>  | 43795.43   | 20  | 28    |
| D1   | Sucrose | -1.204119983      | 0.740396 | 0.501238 | 0.75    | 0.5     | 0.009604 | -0.00124 | 0.009683 |                 |                 | 43795.42   | 20  | 6     |
| D2   | Sucrose | -1.204119983      | 0.728754 | 0.508663 | 0.75    | 0.5     | 0.021246 | -0.00866 | 0.022944 |                 |                 | 43795.42   | 20  | 13    |
| D3   | Sucrose | -1.204119983      | 0.739232 | 0.497525 | 0.75    | 0.5     | 0.010768 | 0.002475 | 0.011049 |                 |                 | 43795.43   | 20  | 47    |
| D4   | Sucrose | -1.204119983      | 0.729919 | 0.508663 | 0.75    | 0.5     | 0.020081 | -0.00866 | 0.02187  |                 |                 | 43795.45   | 20  | 89    |
| D5   | Sucrose | -1.204119983      | 0.745052 | 0.497525 | 0.75    | 0.5     | 0.004948 | 0.002475 | 0.005532 |                 |                 | 43795.44   | 20  | 68    |
| D6   | Sucrose | -1.204119983      | 0.725262 | 0.512376 | 0.75    | 0.5     | 0.024738 | -0.01238 | 0.027661 | <b>0.016457</b> | <b>0.003957</b> | 43795.43   | 20  | 41    |

- Excel file of the dataset for a single test of one subject (shown above) can be formatted in any way convenient for the analysis
- Example shown is a template often used by Opertech for concentration-response analysis
  - Coordinates of each response (columns E and F) are compared with ideal coordinates for target of interest (columns H and I) and plugged into the distance equation (columns K and L) yielding the distance of the subject's response from the target (column N)

# Tracking Repeatability of Results from Individual Subjects



SUBJECT 1077 M

| Test Date       | 12/5/2017        | 12/12/2017 | 3/10/2018 | 3/12/2018 | 3/13/2018 | 3/14/2018 |
|-----------------|------------------|------------|-----------|-----------|-----------|-----------|
|                 | <b>EC50 (mM)</b> |            |           |           |           |           |
| DIPHENHYDRAMINE | 1.2              | 1.4        | 1.2       | 1.3       | 1.3       | 0.71      |
| QUININE         | 0.05             | 0.06       | 0.03      | 0.11      | 0.05      | 0.07      |
| ALOIN           | 0.003            | 0.006      | 0.003     | 0.014     | 0.003     | 0.004     |



# TāStation<sup>®</sup> Applications

- **Taste Properties of Pharmaceuticals**
  - Concentration-response ranging achieved with a fraction of a single daily dose
- **Screening for bitterness mitigation**
  - Rapid identification of ingredients effective at countering aversive tastes of APIs
- **Formulation optimization**
  - Rapid screening and prioritization for best tasting formulations
  - Combinatorial strategy for testing of ingredient mixtures
- **Consumption Model**
  - Objective quantification of palatability
- **Managing Subject Pool**
  - Rapid screening and evaluation of subjects prior to inclusion in a study
  - Tracking individual performances from test to test
- **Data mining**
  - Post-hoc queries on taste sensitivities and preferences across demographics