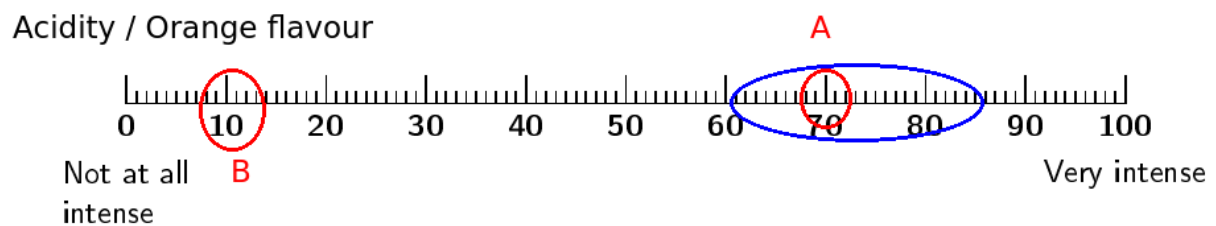
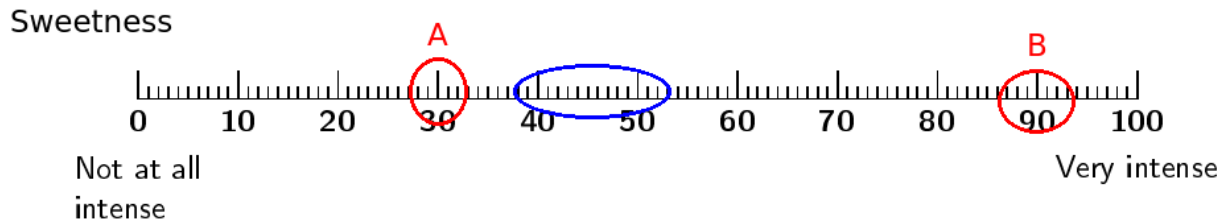


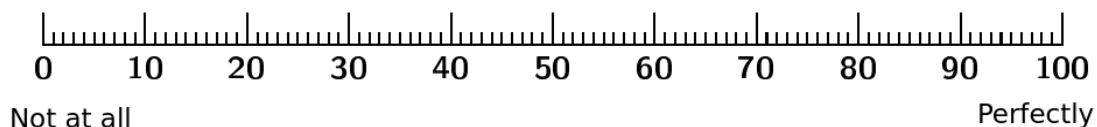
## Open Food Integrated Experiment II – Providing orange beverages that match consumers' preferences

We want to make orange drinks tailored to people's desires. To test this, we supply two reference drinks and ask the participant to provide ratings on the intensity of the drinks' sweetness and acidity/orange flavour. On the same scale, we ask the consumer to rate how they would prefer it to taste. An example is given in the figure below. The red ellipses indicate the ratings of the reference drinks and the blue ellipses indicate the participant's preferences.



Providing ratings of reference drinks enables us to map the scale of the consumers perceptions to the ingredient quantities. We then make a drink with the ingredients that we think should best match the participant's desired perception and ask them to rate how well the drink matches what they want.

How well does the drink match your desired ratings?



We want to avoid participants saying they are completely happy with the first drink and don't want anything different. Therefore, we will give two unpleasant drinks first with an extreme amount of one ingredient. For example, we may provide a drink with no sugar and a high amount of sugar (5g/100ml), but normal amounts of citric acid and orange concentrate.

## How we will map perceptions to ingredients

The rating of each perception  $p$  is mapped to an ingredient quantity  $g$ .

Commonly, this mapping is a power law ( $p = g^a$ ) but for acidity and orange flavour the power  $a$  is close to 1, so we can assume a linear relationship for these two perceptions/ingredients. This linear perception is mapped through the function  $p = a + bg$ .

The functions are as follows:

	Sugar	Citric Acid	Orange Concentrate
Sweetness	$p = g^{0.74}$	-	-
Acidity	-	$p = g$	$p = 0.22 + g(0.52)$
Orange Flavour	-	$P = 0.14 + g(0.75)$	$p = 0.09 + g(0.84)$

### Sweetness

From our previous experiment, we found that sugar interacts with perceived sweetness but not with perceived acidity or orange flavour. Likewise, citric acid and orange concentrate quantities did not strongly interact with perceived sweetness. Based on this, we make the assumption that sugar and sweetness are related only to each other and not to other ingredients or perceptions.

### Acidity

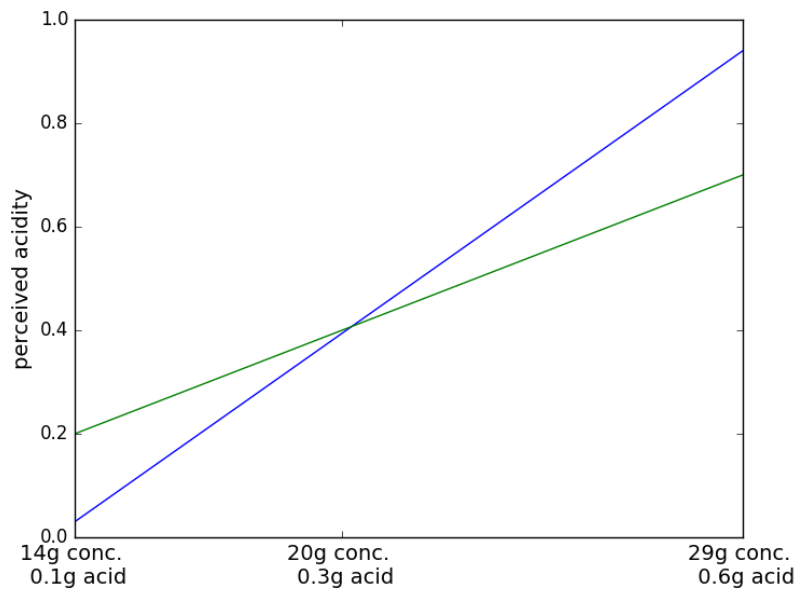
Perceived acidity is affected by citric acid content and orange concentrate content. This is shown in the figure below. In the x axis:

- the upper labels are the amount of orange concentrate (ranging from 14g to 29g) when citric acid is fixed at 0.3g. The green line in the figure maps how the changes in orange concentrate (when citric acid is fixed) relate to the perception of acidity.
- the lower labels are the amount of citric acid (ranging from 0.1 to 0.6g) when orange concentrate is fixed at 20g. The blue line in the figure maps how the changes in citric acid (when orange concentrate is fixed) relate to the perception of acidity.

For example, if a participant wants a drink rated 0.6 on the acidity scale, we can give them a drink with either

- 26g of orange concentrate and 0.3g of citric acid (based on the function shown with a green line) or
- 0.4g citric acid and 20g of orange concentrate (based on the function shown with the blue line)

Because both citric acid and orange concentrate affect perceived acidity, we can choose to change just one of these ingredients to gain the change in perception. Changing both will have a stronger affect, but we don't know by how much.



## Orange Flavour

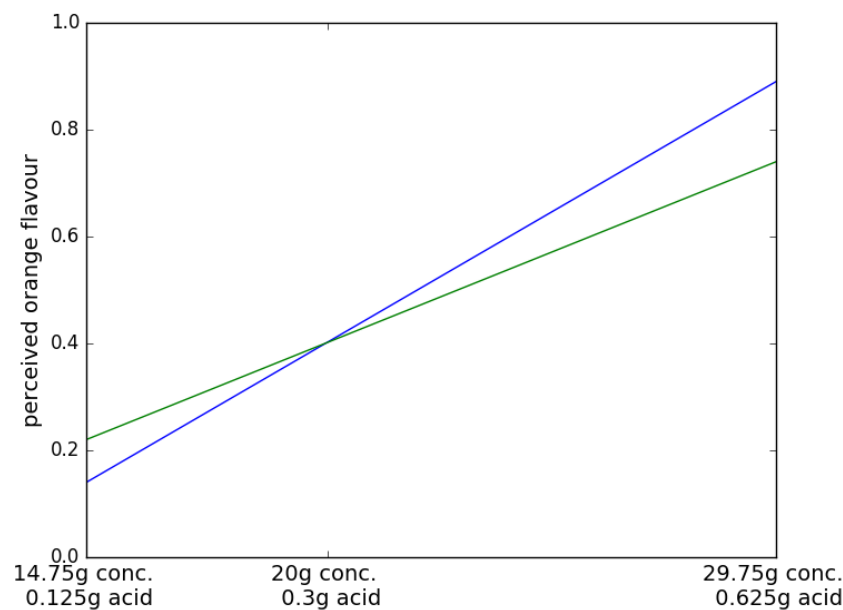
Likewise, perceived orange flavour is affected by both citric acid content and orange concentrate content. This is shown in the figure below. In the x axis:

- the upper labels are the amount of orange concentrate (ranging from 14.75g to 29.75g) when citric acid is fixed at 0.3g. The green line in the figure maps how the changes in orange concentrate (when citric acid is fixed) relate to the perception of orange flavour.
- the lower labels are the amount of citric acid (ranging from 0.125 to 0.625g) when orange concentrate is fixed at 20g. The blue line in the figure maps how the changes in citric acid (when orange concentrate is fixed) relate to the perception of orange flavour.

For example, if a participant wants a drink rated 0.6 on the orange flavour scale, we can give them a drink with either

- 25.7g of orange concentrate and 0.3g of citric acid (based on the function shown with a green line) or
- 0.43g citric acid and 20g of orange concentrate (based on the function shown with the blue line)

Again, because both citric acid and orange concentrate affect perceived orange flavour, we can choose to change just one of these ingredients to gain the change in perception.



## Avoiding contradictions

The above shows that perceived orange flavour and acidity both increase with amounts of citric acid and orange concentrate. As a result, it is not possible to provide for ratings of orange flavour and acidity that differ.

For example, if a participant wants acidity rated at 0.5 we would need

- either 0.35g acid and 20g orange
- or 0.3g acid and 23g orange

and if the participant also wants orange flavour rated 0.8, we would need

- either 0.565 acid and 20g orange
- or 0.3g acid and 31.5 orange

This suggests we cannot provide a drink that is rated 0.5 in acidity and 0.8 in orange flavour.

To avoid this issue, it may be best to force participants to rate acidity and orange flavour as one single attribute. Though the functions mapping citric acid and orange concentrate to the perceptions of acidity and orange flavour are not exactly the same, since perceptions are inherently imprecise and the functions are fairly similar, it may be safe to make the assumption that the functions are the same.

## Workshop Plan

- One day workshop in Building 33 L&D Room at Cranfield Uni (16<sup>th</sup> of May)
- Half an hour slot will be given to the each participant
- We will start with reference drinks, then we will ask them to define their preferred corresponding sensory attributes as interval valued responses.
- We will calculate the required physical amount of the corresponding ingredients to tailor the individual`s drink.
- A final rating questionnaire (0 to 5 scale) will be given to the participants to rate the performance of the tailored drink (0 means not match at all, 5 mean perfectly match).

## Ingredients:

- Food grade ingredients are used
- All ingredients are purchased from Sigma-aldrich

## Participants Selection:

1. Be at least 18 years old or older
2. Be in good health, in general and specifically on the day of sensory training and tasting
3. Have no allergies or sensitivities to any food products (especially for orange flavoured beverages)
4. Be free from health conditions which restrict their food choices
5. Have the ability to evaluate the taste, flavour, texture and appearance of beverages
6. Be available to attend sensory evaluation and preference marketplace sessions.