AN INVESTIGATION INTO TASTE PERCEPTION

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CONTENTS

ABSTRACT

This study investigated taste perception of Irn-Bru, Scotland's Other National Drink. The aim of this investigation was to assess the influence of visual cues on taste perception. An experiment using a repeated measures design was carried out. The independent variable (I.V.) was egg yellow food colouring in lemonade in Condition B and the dependent variable (D.V.) was the observation and measurement of participant response to the Condition B manipulation of lemonade with egg yellow. 20 participants were selected by opportunity sampling to participate in the study who were required to taste 4 separate drinks and state what they thought the taste was. Results were analysed using descriptive statistics and inferential statistics. Analysis of recorded results using a related t-test gave a t value of 10.376. Critical t for a one-tailed test with 19 degrees of freedom at the 0.05 level of significance gave a tabled value of 1.729. This allowed rejection of the null hypothesis and acceptance of the experimental hypothesis H_1: "That when visual cues are frustrated, taste perception will be adversely affected."

INTRODUCTION

The purpose of this investigation was to assess the influence of visual cues on taste perception.

Perception is the process by which we take in raw sensations from our environment using our senses and interpret these sensations using our past knowledge and understanding of the world in order that the sensation, or what we are sensing, becomes meaningful to us.

Taste is one of the five senses, affected by the contact of soluble substances on the tongue. Although humans can distinguish between a wide range of flavours, the sensation of taste is actually a response to a combination of several stimuli, including texture, temperature, and smell, as well as taste.

In isolation, the sense of taste can only identify four basic flavours: sweet, salt, sour and bitter, with individual taste buds particularly responsive to one of these.

The 10,000 or so taste buds found in humans are distributed unevenly over the top of the tongue, creating patches sensitive to specific classes of chemicals which give the taste sensations.

Chemicals from food are dissolved in the moisture of the mouth and enter the taste buds through pores in the surface of the tongue where they come into contact with sensory cells.

When a receptor is stimulated by one of the dissolved substances, it sends nerve impulses to the brain. The frequency of the repetition of the

impulse tells the brain how strong a flavour is and the type of flavour is registered by the nerve cells that responded.

Taste perception is a result of our sense of vision, taste and smell all working together. Previous past experience is also an issue.

It is likely that people learn and become familiar with specific combinations of colours and tastes. These learned associations might alter our perceptions and create expectations about how a food or drink should smell and taste.

In this experiment, lemonade was mixed with egg yellow food colouring until it resembled Irn-Bru.

In Scotland, Irn-Bru is a popular fizzy drink, which is advertised as 'Your Other National Drink', and has also been described as 'Made in Scotland from Girders'.

Since perception is partly dependent on meaningful past experience, this experiment on taste perception, carried out in Scotland, could be influenced by culture.

Culture refers to the way of life of a society; it covers all the folkways of a society, such as language, customs, dress, as well as the symbols and artefacts, which people develop.

Dubose, C.N. (1980) experimented on the effects of colourants on identification of fruit-flavoured beverages. Cherry, lemon-lime and orange drinks were coloured red, orange or green. It was found to be easier for the participants to identify the correct flavour when the drink had the expected colour. For example, an orange-coloured drink that was really cherry-flavoured was often thought to taste like an orange drink; a green coloured cherry drink would be reported as tasting like lime. Only 50% of participants

correctly identified lemon-lime, 30% correctly identified cherry, and only 20% correctly identified orange.

Oram, N. (1995) investigated the influence of colour on drink identification by children and adults. The participants were divided into 5 age groups, and were given drinks coloured brown, orange, yellow or red. After tasting each drink, the participants had to choose whether the drink was chocolate, orange, pineapple or strawberry.

Results found that younger participants made more colour-associated errors. They relied on the colour of the drink more than the older participants to make a decision about its taste.

Stillman, J.A. (1993) experimented on how colour influences flavour identification in fruit-flavoured beverages. Uncoloured, red, yellow-orange and green colours were used to test the ability of participants, who were at least 15, to identify raspberry-flavoured and orange-flavoured drinks.

These results showed that the ability to identify raspberry and orange flavours correctly was reduced in uncoloured and 'odd-coloured' drink samples.

The aim of this investigation was to assess the influence of visual cues on taste perception.

The experimental hypothesis was H_1: "That when visual cues are frustrated, taste perception will be adversely affected." This is a one-tailed hypothesis because it is predicting the direction of the results.

The null hypothesis was H_0: "That the frustration of visual cues will have no adverse effect on taste perception at the 0.05 level of significance."

METHOD

Design

A repeated measures laboratory experimental design was used, meaning one group of participants undergoing both conditions of the I.V. In this experiment, there were 2 conditions. Condition A was the tasting of plain lemonade and orangeade and Condition B was the tasting of lemonade mixed with egg yellow food colouring and orangeade.

This design was used to have good control of extraneous variables. These could be in the environment and might affect the results of the experiment.

Other advantages of using a repeated measures design also means the statistics are more sensitive, and fewer participants are needed.

The main disadvantage of this design is order effect in the participants. This is when practice, fatigue or boredom can influence their performance. To control for order effect counter balancing was applied, using the ABBA technique. This was when the sequence of the drinks was changed. Participants 1, 3, 5, 7 etc. were given lemonade, orangeade, orangeade, and then lemonade mixed with egg yellow food colouring, while participants 2, 4, 6, 8, etc. were given orangeade, lemonade, lemonade mixed with egg yellow food colouring, orangeade.

The Independent Variable (I.V.) was the egg yellow food colouring in the lemonade in Condition B and the Dependent Variable (D.V.) was the observation and measurement of participant response to the Condition B manipulation of the lemonade plus the egg yellow food colouring.

Participants

The participants were 20 individuals selected by opportunity sampling, from Kilmarnock College.

This sampling method was used for convenience and availability. There were 12 female participants and 8 male participants who had no prior knowledge of psychology.

Apparatus

Counterbalancing chart – see appendix i on page 17

80 Disposable cups

1l lemonade

1l orangeade

38ml egg yellow food colouring

Data response sheet – see appendix ii on page 18

Procedure

Before the actual experiment, a pilot study was carried out on a small group to standardise the instructions and to identify any ambiguities.

Permission was asked from Gianna Devin, head of Social Science faculty, to conduct the experiment in the college. This was done by letter – see appendix iii on page 19

Before the participants arrived, half of the lemonade was mixed with egg yellow food colouring until it resembled Irn-Bru.

A small amount of lemonade, lemonade mixed with egg yellow food colouring and 2 amounts of orangeade was poured into 4 of the cups for each participant.

Each participant was dealt with individually, and the same conditions were used for all participants. They were asked if they would like to participate in a psychological experiment. On their consent, they were told it was an experiment into taste perception.

At this point, they were given the opportunity to withdraw from the experiment.

On entering the laboratory, they were asked to taste the liquid in the 4 cups, 1 at a time, and say what they thought it was that they were drinking. Their answers were written down as well as any further comments they made. This is known as introspection.

After the experiment, according to the British Psychological Society ethical guidelines they were thanked for participating, debriefed regarding the true purpose of the experiment and told when they would be able to read the finished report.

RESULTS

Measures of central tendency were used in the results procedure. These are different ways to discover the average of all scores recorded. The mean, median, and mode were all found. The definition of mean is the average, found by adding all scores and dividing by the number of participants taking part, the median is the middle number when all scores are put in numerical order, and if there is an even number of these, the middle two are taken and divided by two, and the mode is the most frequently occurring score.

Condition A: MEAN = 1.95

MEDIAN = 2

MODE = 2

Condition B: MEAN = 1.15

MEDIAN = 1

MODE = 1

The experimental hypothesis was tested using a Binomial Sign Test

As can be seen in appendix iv on page 20 there are 4 ties, therefore $N = 16$. Calculated $s = 0$ because there are 16 (-) and 0 (+).

When $N = 16$, calculated s must be equal to or less than 4 for a one-tailed test at the 0.05 level of significance in the binomial sign test table.

In this experiment, since $s = 0$ the null hypothesis can be rejected and the experimental hypothesis can be accepted.

An inferential statistic called the related t-test was used. This was appropriate because the research hypothesis predicted a difference due to visual cues in Condition B, there was interval data and because a repeated measures design was used, providing related data.

The formula for the related t-test is:

$$t = \frac{\Sigma d}{\sqrt{\frac{N \Sigma d^2 - (\Sigma d)^2}{N - 1}}}$$

For this experiment, a one-tailed test at the 0.05 level of significance with 19 degrees of freedom, t must equal or exceed 1.729. Since in this experiment t = 10.378, as shown in appendix v on page 21 the null hypothesis can be rejected and the experimental hypothesis can be accepted.

DISCUSSION

The purpose of this investigation was to assess the influence of visual cues on taste perception.

Analysis of recorded results gave a mean value for Condition A of 1.95, a median value of 2 and a mode of 2. For Condition B the mean value was 1.15, the median value was 1, and the mode was 1.

In the binomial sign test, *s* had to be equal to or less than 4 for a one-tailed test at the 0.05 level of significance when $N = 16$, and since $s = 0$, this meant the null hypothesis H_0: "That the frustration of visual cues will have no adverse effect on taste perception at the 0.05 level of significance" could be rejected and by counterintuition, the experimental hypothesis H_1 : "That when visual cues are frustrated, taste perception will be adversely affected" could be accepted.

In the light of the hypotheses, the results of the related t-test, to find out if the results were significant, showed t must equal or exceed 1.729, and in this experiment t = 10.378, which meant that the null hypothesis H_0: "That the frustration of visual cues will have no adverse effect on taste perception at the 0.05 level of significance" could be rejected, therefore the experimental hypothesis H_1 : "That when visual cues are frustrated, taste perception will be adversely affected" could be accepted.

Descriptive statistics in appendix vi on page 23 show 19 out of 20 participants guessed correctly in Condition A, but only 3 out of 20 guessed correctly in Condition B.

In the light of comparable studies, these results support results from Dubose, C.N. (1980), Oram, N. (1995), and Stillman, J.A. (1993) who discovered that visual cues do adversely affect taste perception.

Dubose, C.N. (1980) used cherry, lemon-lime and orange drinks which were coloured red, orange or green. The results found that it was easier for the participants to identify the correct flavour when the drink had the expected colour. 50% of participants correctly identified lemon-lime, 30% correctly identified cherry, and only 20% correctly identified orange, which showed that visual cues were influencing taste perception.

Oram, N. (1995) also investigated the influence of colour on drink identification. Participants were given drinks coloured brown, orange, yellow or red. After tasting each drink, the participants had to choose whether the drink was chocolate, orange, pineapple or strawberry.

Results found that younger participants relied on the colour of the drink to make a decision about its taste more than the older participants.

Stillman, J.A. (1993) experimented on how colour influences flavour identification in fruit-flavoured beverages. Uncoloured, red, yellow-orange and green colours were used to test the ability of participants to identify raspberry-flavoured and orange-flavoured drinks.

Results showed that the ability to identify raspberry and orange flavours correctly was reduced in uncoloured and 'odd-coloured' drink samples, again illustrating how visual cues adversely affected taste perception.

Scientists have discovered that knowing the brand of a soft drink can influence an individual's perception of what it tastes like. When undertaking a taste challenge, brain scans showed that when the volunteers knew which

brand they were tasting, the parts of the brain involved with recalling memories were activated.

When the volunteers were unaware which beverage they were drinking, they expressed no preference for one over another. However, when they were given visual clues to the brand they were drinking, they expressed a definite preference.

Brain scan results showed that knowledge of the brand influenced preference and activated brain areas including the dorsolateral prefrontal cortex and the hippocampus. These areas are involved in recalling cultural influences and modifying behaviour based on emotion and mood.

Lead researcher, Dr. Read Montague said, "We live in a sea of cultural images. Those messages have insinuated themselves in our nervous system."

Dr John O'Doherty, a research scientist at University College London's Functional Imaging Lab, said it was widely known that perception of the taste or smell of a food item can be influenced by other information such as the images, texture or sounds associated with that food. People's decisions or preferences can be influenced by providing different contextual information. One such way is by associating a brand with other pleasant, rewarding things.

There were areas in this investigation which could have been improved.

For this research to be more representative, more participants could have been used. If a larger, more representative sample had been used, results could have been generalised further, rather than only to Kilmarnock College.

A better design might have been matched pairs, where the participants only undergo one condition of the I.V., thus order effect can be avoided.

Also another sampling method could have been used, such as a random design, where everybody has an equal chance of being selected.

For future research, gender differences could be studied to discover if this affects results, or age differences to find out if a person's cultural preferences change with age.

CONCLUSION

This experiment was a study into taste perception. Its aim was to determine whether visual cues influenced taste perception.

Analysis of recorded results using a related t-test gave a t value of 10.376. Critical t for a one-tailed test with 19 degrees of freedom at the 0.05 level of significance gave a tabled value of 1.729.

These results conclude that visual cues do adversely affect taste perception.

Thus as a consequence, the null hypothesis was rejected and the experimental hypothesis H_1: "That when visual cues are frustrated, taste perception will be adversely affected" was accepted.

REFERENCES

http://faculty.washington.edu/chudler/coltase.html

DuBose, C.N. (1980) *Journal of Food Science, 45:1393-1399, 1415*

Oram, N. (1995) *Dev. Psychobiology, 28:239-46*

Stillman, J.A. (1993) *Journal of Food Science, 58:810-812*

http://newsvote.bbc.co.uk/mpapps/pagetools/print/news.bbc.co.uk/2/hi/hea;th/3739462....

BIBLIOGRAPHY

Coolican, H. (2004) *Research Methods and Statistics in Psychology* (4th edition). London: Hodder & Stoughton.

Keegan, G. (2002) *Higher Psychology Approaches and Methods.* London: Hodder & Stoughton.

http://athena.english.vt.edu/~carlisle/Postcolonial/Concepts_and_Issues/Identity.html

http://www.napier.ac.uk/depts/pas/CulturalStudies/IrnBruFactor.htm

http://business.scotsman.com/print.cfm?id=91652005&referringtemplate=http%3A%2...

http://www.bbc.co.uk/dna/h2g2/A219863

http://www.sewanee.edu/chem/Chem&Art/Detail_Pages/ColorProjects_2003/Haney/in....

http://www.foodproductdesign.com/archive/1996/1096QA.html

Appendix i

Counterbalancing Chart

Participant	Condition A		Condition B	
1	Lemonade	Orangeade	Orangeade	Irn-Bru mix
2	Orangeade	Lemonade	Irn-Bru mix	Orangeade
3	Lemonade	Orangeade	Orangeade	Irn-Bru mix
4	Orangeade	Lemonade	Irn-Bru mix	Orangeade
5	Lemonade	Orangeade	Orangeade	Irn-Bru mix
6	Orangeade	Lemonade	Irn-Bru mix	Orangeade
7	Lemonade	Orangeade	Orangeade	Irn-Bru mix
8	Orangeade	Lemonade	Irn-Bru mix	Orangeade
9	Lemonade	Orangeade	Orangeade	Irn-Bru mix
10	Orangeade	Lemonade	Irn-Bru mix	Orangeade
11	Lemonade	Orangeade	Orangeade	Irn-Bru mix
12	Orangeade	Lemonade	Irn-Bru mix	Orangeade
13	Lemonade	Orangeade	Orangeade	Irn-Bru mix
14	Orangeade	Lemonade	Irn-Bru mix	Orangeade
15	Lemonade	Orangeade	Orangeade	Irn-Bru mix
16	Orangeade	Lemonade	Irn-Bru mix	Orangeade
17	Lemonade	Orangeade	Orangeade	Irn-Bru mix
18	Orangeade	Lemonade	Irn-Bru mix	Orangeade
19	Lemonade	Orangeade	Orangeade	Irn-Bru mix
20	Orangeade	Lemonade	Irn-Bru mix	Orangeade

Appendix ii

Data Response Sheet

Participant	Condition A		Condition B	
1	Lemonade	Orangeade	Orange	Lemonade/Orangeade
2	Orange	Lemonade	Orange	Orange
3	Lemonade	Orange	Orange	Lucozade
4	Orange	Lemonade	Lemonade	Orange
5	Lemonade	cheap Orangeade	Not so cheap Orangeade	Lucozade
6	Orange	Lemonade	Cheap Irn-Bru	Orange
7	Lemon	Orange	Orange	Irn-Bru
8	Tangerine	Sprite	Cheap/flat Irn-Bru	Tangerine
9	Lemonade	Orange	Orange	Irn-Bru
10	Fanta	Sprite/7up	Flat Irn-Bru	Fanta
11	Sprite	Orangeade	Orangeade	Irn-Bru
12	Orange	Lemonade	Lemonade	Orange
13	Lemonade	Orange	Grapefruit	Lemonade
14	Orangeade	Sprite	Orange	Orange
15	Lemonade	Fanta	Diet Fanta	Irn-Bru
16	Orange	Lemonade	Orange	Orange
17	Lemonade	Orange	Orange	Irn-Bru
18	Orange	Lemonade	Irn-Bru	Orange
19	Lemonade	Pineapple	Orange	cheap Irn-Bru
20	Orange	Lemonade	Orange	Orange

Appendix iii

Letter to Gianna

114 Lainshaw Avenue
Kilmarnock
KA1 4TF
8TH March 2005

Head of Social Science Faculty
Kilmarnock College
Holehouse Road
Kilmarnock
KA3 7AT

To Gianna Devin,

We are writing to apply for permission to use a room on the yellow floor to carry out a psychology experiment as part of our HND course.

As the experiment involves opportunity sampling, the room may be needed for most of the day,

Thank You,

Gail McHugh and Andrew Sim.

Appendix iv

Binomial test data

Participant	Condition A	Condition B	B-A Sign of d
1	2	2	
2	2	1	-
3	2	1	-
4	2	2	
5	2	1	-
6	2	1	-
7	2	1	-
8	2	1	-
9	2	1	-
10	2	1	-
11	2	1	-
12	2	2	
13	2	1	-
14	2	1	-
15	2	1	-
16	2	1	-
17	2	1	-
18	2	1	-
19	1	1	
20	2	1	-

Since there are 4 ties, $N = 16$. Calculated $s = 0$ because there are 16 (-) and 0 (+).

When $N = 16$, calculated s must be equal to or less than 4 for a one-tailed test at the 0.05 level of significance in the binomial sign test table.

In this experiment, since $s = 0$ the null hypothesis can be rejected and the experimental hypothesis can be accepted.

Appendix v

Related t-test

Condition A Results	Condition B Results	d (A-B)	d^2
2	2	0	0
2	1	1	1
2	1	1	1
2	2	0	0
2	1	1	1
2	1	1	1
2	1	1	1
2	1	1	1
2	1	1	1
2	1	1	1
2	1	1	1
2	2	0	0
2	1	1	1
2	1	1	1
2	1	1	1
2	1	1	1
2	1	1	1
2	1	1	1
2	1	1	1
1	1	1	1
2	1	1	1
		$\Sigma d = 17$	$\Sigma d^2 = 17$

$(\Sigma d)^2 = 289$

$$t = \frac{\Sigma d}{\sqrt{\frac{N \Sigma d^2 - (\Sigma d)^2}{N - 1}}}$$

$N \Sigma d^2$ = 20 x 17 = 340

340 – 289 = 51

N = 20

N – 1 = 19

51 ÷ 19 = 2.684

$\sqrt{2.684} = 1.638$

17 ÷ 1.638 = 10.378

t = 10.378

Degrees of freedom = N – 1 = 19

For a one-tailed test at the 0.05 level of significance with 19 degrees of freedom, t must equal or exceed 1.729. Since in this experiment t = 10.378, the null hypothesis can be rejected and the experimental hypothesis can be accepted.

Appendix vi

Bar graph of participants' scores