

# EFFECTS OF PACKAGE ON TASTE PERCEPTIONS FOR FRUIT JUICES

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## ABSTRACT

This study investigated how congruent and incongruent images attached to the juice packages influence taste evaluations. 42 subjects were randomly assigned for one of two experimental conditions, congruent where orange pictures were used or incongruent where pictures of non-food objects were used. The subjects rated their actual palatability, goodness of odor, sweetness, bitterness, sourness, richness, freshness and artificiality of 6 juice samples. 3 samples were attached 3 images which randomly selected from 12 images within one condition, and another was attached 3 scrambled images of these images. Congruent images influenced goodness of odor, and incongruent images influenced freshness and artificiality. These data shows that images attached to the juice packages influence taste evaluations.

**Keywords:** package, labeling, image, taste, congruency

## 1. INTRODUCTION

Numerous factors play a role in the taste processing. In particularly it is known that visual information plays an important role in food cognition. A number of studies have reported the influence of color of drink on taste perception [1][2], liking [3], accessibility and odor intensity [4], drink identification [5] and discrimination of color [6]. These studies reported the effect of color of drink itself. However we cannot always see color of commercial drink. Drink almost always is covered with packages. Thus, the research on the effect of packages on taste perception is needed.

What is revealed about effects of food packages is showed as follows. Food packages usually include textual information (e.g. the brand name) and image information (e.g. the picture). So far, most studies that examined influence of packages on taste perception have focused on textual information. It has been reported that the brand names shown on packages influence hedonic evaluations of taste [7] and liking [8], wine labels influence tastiness of wine [9] and nutrition labeling affects on is betterliking of taste [10]. These studies demonstrated that textual information on packages influence flavor evaluations. In contrast, only a few studies have focused on the effect of images on flavors. Rosires et al. (2003) reported the influence of packaging factors on expected sensory attributes of passion fruit juice [11]. In their study, using 24 computer generated package images, 6 factors (background color, picture, textual information, brand, language and shape) were manipulated. Subjects rated expected sweetness, pureness, sharpness, refreshing, freshness, naturalness and liking of drinks based on the package. They found that, in addition to the textual information and background color, pictures shown on the package had a significant effect on the evaluation of these expected sensory attributes. Their result indicated that pictures influence taste perception, however, they focused on expected sensory attributes, thus subjects did not taste the drink.

Only one study, as far as we know, examined the influence of images on actual taste perception [12]. In their experiment, 48 subjects tasted fruit juices while they saw pictures of fruits projected on head mounted display, and rated palatability, sweetness and sourness of the juices. They discovered that when pictures congruent to the juices (e.g. orange pictures for orange juices) were used, juices were evaluated as more palatable than in conditions when incongruent or no images were used, sweeter than conditions when no images were used, and sourer than condition when incongruent images were used. This study showed that fruit images influenced ratings of actual taste of fruit juices. However, packages sometimes have images not directory related to the drink, such as cute animals, cartoon characters and beautiful sceneries. How those images affect evaluations of tastes has not studied so far.

In this study, we investigated how congruency of images influence taste evaluations of orange juice. In this way we hope to reveal the relationship between taste and package design and to make use of this result for package design.

## **2. METHOD**

### **2.1. Subjects**

Subjects were 42 students recruited from the University of Tsukuba, 29 females and 13 males, aged 18-28 years. All had a self-reported normal sense of taste. They were randomly assigned for one of two experimental conditions, congruent where orange pictures were used or incongruent where pictures of non-food objects were used. They were informed of the general procedure but not the purpose of the experiment, and all subjects gave their written consent. The study was approved by the institutional ethics committee of Graduate School of Comprehensive Human Sciences, University of Tsukuba.

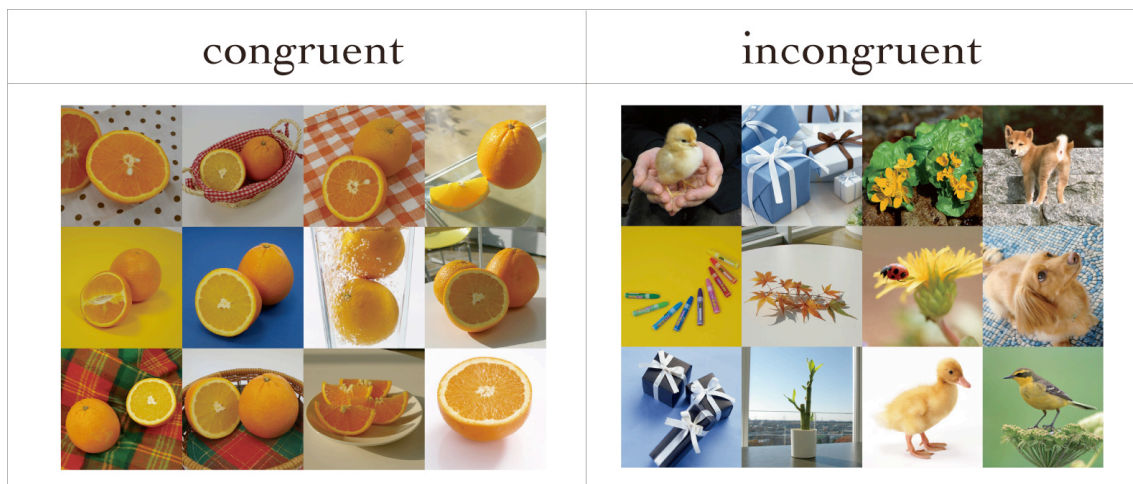
## 2.2. Stimuli

### 2.2.1. Preparation of image stimuli

Image stimuli was selected based on the pre-experiment in which 19 subjects (6 females and 13 males) aged 20-37 years evaluated how they feel about images.

We used a set of digitized color photograph images for two conditions; images of oranges for the congruent condition, images of non-food pleasant objects for the incongruent condition. Most of the images were taken by one of the authors so as to control the lighting and background. We supplemented these with some images from web sites and photograph book to increase the variety.

In the pre-experiment, 40 images (20\*2 conditions) were 50-mm-square, presented on the paper in random order and rated valence and arousal using 9-point scales. Left side of scales were -3=extremely unpleasant for valence and -3=extremely calm for arousal. Right side of scales +3=extremely pleasant for valence and +3=extremely aroused for arousal. The center of scales was 0=neutral. We selected images that there is no significant difference between ratings of two conditions stimuli. 24 images (12\*2 conditions) were determined as stimuli in this procedure (FIG. 1).



**Figure 1:** Image stimuli of two conditions.

Out of these 12 images, we randomly selected 3 images for each subject. As some of the images were similar, we defined similar images in advance, and we avoided selecting them together. All the images were used with a similar frequency. Evaluation of juice tastes likely varies across subjects. To control this, we performed a baseline session for each subject where scrambled images were used in place of experimental images. The scrambled images were constructed by randomly rearranging 1x1 mm pixel areas. This allowed making baseline stimuli whose mean color and brightness were the same as the experimental stimuli.

### 2.2.2. Image presentation condition

Each image was printed on a 50-mm-square glossy paper (A-ONE. Co. Ltd, Tokyo, glossy label for ink-jet A4 size) using an ink-jet printer (SEIKO EPSON CORPORATION,

Nagano, PM-3700C). We added three digit random numbers at upper left of images so that subjects could match each sample to a rating sheet. This also forced subjects to look at image at least once before they rate the juice. Numbers were printed in 18pt Helvetica, with either black or white ink depending on the background color of the image. The same colors were used for experimental image and corresponding baseline scrambled image. Images were attached to the top of black disposable plastic cups (SOLO P400 4-oz) that were covered with aluminum foil.

### 2.2.3. Evaluation item scales

There are many possible descriptors for sensory attributes of orange juice. Therefore, we chose descriptors and attributes that people consider important for the evaluation of orange juice to use as evaluation items. Screening of evaluation items was conducted as follows.

First, we listed as many descriptors as possible for orange juice. 5 including authors participated in this process. Then, for the resulting 26 descriptors, we obtained ratings for understandability and importance for flavor evaluation of orange juice (2=clearly understandable or extremely important, 1= somewhat understandable or a little important, 0= not understandable or unimportant) from 8 subjects. Among the descriptors that more than half of the subjects rated as clearly understandable, we ranked descriptors based on total important scores and selected top 8. Selected descriptors were palatability, goodness of odor, sweetness, bitterness, sourness, richness, freshness and artificiality. For palatability and goodness of odor, we used a 201-point unipolar scale where +100 was “extremely palatable” or “extremely good odor”, -100 was “extremely unpalatable” or “extremely bad odor”, and 0 was “neither palatable nor unpalatable” or “neither good nor bad odor”. For others, we used visual analog scale where the right pole was “very strong”, and the left pole was “none”.

## 2.3. Procedure

Using a between-subject design, each subject was assigned to one of two conditions: congruent and incongruent. We used between-subject design to minimize the chance for subjects to recognize the aim of the study. This was also to avoid situations where one condition influenced later conditions which may happen in a within-subject design. Experiment for each group was conducted separately so that subjects are not exposed to different conditions.

Experimental procedures were the same for all the conditions. First, subjects were given general instructions and informed of the aim of the study. We stated that the purpose of the experiment was to collect subjective ratings of juices, with the actual purpose was given after they completed the experiment. They performed a brief practice session using a sample presented with the scrambled image. Then, subjects participated in experiment and baseline sessions. In both sessions, three cups were presented, each labeled with a different image, inserted with straw, and filled with 15 ml of 100 % orange juice (KIRIN Tropicana Ltd, Tokyo, 100% juice orange). In experiment session, experimental images were used, while in the baseline session, scramble images of the corresponding experimental images were used. A baseline session was always preceded an experiment session, as in a pilot experiment, we noted that the effects of experimental images tended to last till the following session when the order was reversed.

The procedure that subjects followed for tasting and rating each juice was as follows. 1) Rinse the mouth with mineral water and spit it out. 2) Write sample numbers on the rating sheet. 3) Take all the juices in the cup into the mouth, taste it, and swallow it. 4) Fill in the rating form. Juice was served at room temperature, which was maintained at approximately 24 degrees.

### 2.4. Data analysis

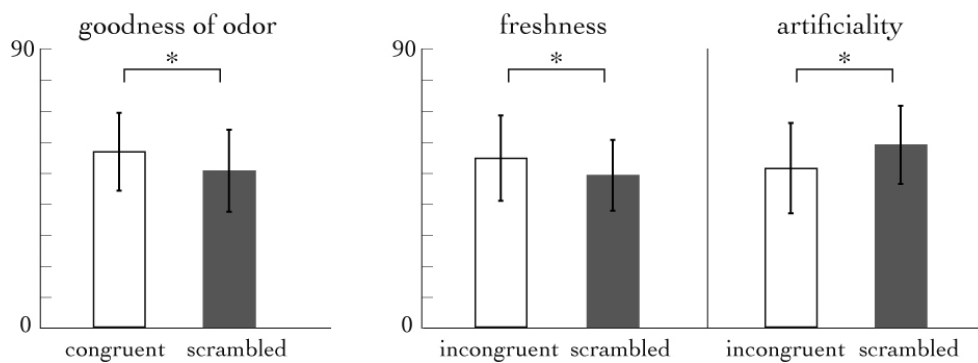
For assigning a value to each of items before any statistical computations could be applied, length between the left extremity and the checked point was calculated, ranged 0-100 in all items. For each subject, we used a mean rating value obtained from the three samples.

To determine the effects of congruent and incongruent images on taste evaluations, one-way repeated ANOVA was performed on the rating scores of experimental images and baseline images for each item. As we compared experimental images and baseline images, the color effects was deducted. All tests used a  $p$  value of  $< 0.05$  to determine significance.

## 3. RESULTS

The mean scores and standard deviations of rating scores on taste evaluations where effects of images were significant are presented in Figure 2.

There is significant effect of congruent images for goodness of odor ( $F(18,1)=5.47$ ,  $p=0.03$ ). Juices presented with congruent images were rated to have better odor compared to scrambled images. There are significant effect of incongruent images for freshness ( $F(22,1)=7.77$ ,  $p=0.01$ ) and artificiality ( $F(22,1)=$ ,  $p=0.02$ ). Juices with incongruent images were more fresh and inartificial compared to scrambled images.



**Figure 2:** Results of taste evaluations: mean scores and standard deviations of rating scores on taste evaluations where effects of images were significant (\*  $p<0.05$ ).

## 4. DISCUSSION

It was revealed that congruent images provide positive effects on goodness of the juice odor and incongruent images provide positive effects on freshness and artificiality. We did not find any significant effects of images on the perceived basic tastes. Therefore, it is likely that basic taste is insusceptible to valence and congruency of the image labels. Okamoto and colleagues reported that name labels, such as lemon had only a slight effect on perceived intensity of basic taste solutions, while the same labels significantly influenced liking and familiarity [13]. Their results and ours suggest that overall impressions such as liking and palatability are susceptible to the labels, while perceived intensity of basic taste is insusceptible to the image and verbal labels.

In Sakai's experiment [12], congruent images increased palatability and sweetness ratings of juices compared to without images. In our experiment, however, congruency of images did not have effects on palatability and sweetness of tastes. The multiple differences between Sakai et al and our experimental design may have caused the different results. First, in the study by Sakai et al., four different juices were presented randomly without informing subjects which juice came next. In such condition, effect of expectation would have been higher than in ours where subjects knew that they would taste orange juice. Another difference is the analysis method. As we used scrambled images that had the same mean color and brightness as experimental images for baseline condition, our analysis likely excluded the effect of color, thus more sensitive to the subject of the image. This also may have caused the difference in results.

In general, there are many packages that are attached to congruent images (e.g. fruits) and incongruent images (e.g. animals and characters) in the market. In this study, we investigated the effect of congruent and incongruent images attached to juice packages on taste evaluations. We showed that juices presented with congruent images were evaluated to have better odor than those presented with scrambled images, and juices presented with incongruent images were evaluated as being more fresh and inartificial than those presented with scrambled images. Thus, it is said that effects of congruent images and incongruent images on tastes were different each other. In the further research, we will reveal the relationship between package images and taste in detail, which enable us to design effective food packages that matches each marketing plan.

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