

Visual versus Text Attribute Representation in Choice Experiments

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Abstract—The purpose of this paper is to investigate the effect of attribute representation format (textual or visual) on willingness-to-pay in choice experiments. In our experiment, we randomly present the user with either the textual or visual format of the choices, and the user is tasked with selecting one of the two alternatives based on the attributes in each choice situation. The same options are available in both textual and visual formats. We found that ..

Index Terms—Attribute Non-Attendance (ANA), Willingness to Pay (WTP), Choice Experiment, Representation format

I. INTRODUCTION

Choice experiments are one of the most popular methods used to elicit consumer WTP for attributes. Choice experiments often involve the judging of consumer behaviour, and decision making behaviour while making decisions in the economic domain. In choice experiments involving private goods, consumers are provided with different products to choose from that vary across attributes. There remains an ambiguity in the attribute presentation format used in choice experiments, due to the fact that the features are comprehended differently. [1] hypothesised that there could be a major impact on the quality of data in the two formats (text or visual) representation format of the attributes. [2] investigated the effect of presentation formats in choice experiments in transportation, and inferred that there wasn't a significant impact in the quality of data. Several researchers typically list the attributes of each product using text only. while some have used shelf simulation to display the product to participants in a visual format similar to how the products would appear in a grocery store, to understand the impact of representation format in choice experiments. An important factor used to analyse the consumers decisions in the economics, involves comparison of WTP. Studies have highlighted the ambiguity of presentation forms in choice trials, which suggest a relationship between presentation formats and WTP based on individual differences in cognitive styles [3]. Many related studies in the field have looked at consumers' willingness to pay (WTP) for different attributes in relation to choice experiments ,for eg. [4], presented the food items in the choice trials using text and visual formats, and discovered that the consumer WTP was higher in cases where text representation was used as opposed to visual presentation. [5] conducted a similar experiment

based on landscape images and found that consumers had greater preferences for attributes with higher visual salience.

A. Visual vs Text Presentation

Researches consider the comparison of visual vs text learning as a major dimension of the cognitive style [3]. Accordingly, the companies have often employed different strategies for targeting the same, visual and text representations for the attributes on their product. There have been many studies on different domains that test the text vs visual presentation format of the attributes, [2] studied visual vs text on sweaters, [1] hypothesised that there could be differences in the individual preferences in the choice tasks depending on the attribute presentation (text or visual). [4] conducted a similar study wherein, they presented the individuals with table vs visual format and concluded that WTP for visual treatment was lower than that of the text treatment of the experiment. [7] found that an addition of the Eco-Label to the product has a major impact on the product valuation and consumer's attention. [6], we hypothesise that the WTP will vary greatly depending on whether the attributes being represented in visual or textual format. We provide the consumer a text-based experiment or a visual experiment to further evaluate the hypothesis. In either of the treatments, the consumer must decide whether to select one of the two alternatives (each with a different set of attributes) or to select neither one, while taking the primary attributes into account, through attribute non attendance methods.

B. Attribute Non-Attendance (ANA)

We take into account ANA (or attribute non attendance) in the choice experiments in order to investigate the visual vs text attribute presentation. ANA mostly occurs when the participant fails to take one or more of the attributes into account when making a choice. It serves as a suitable heuristic and simplifies the decision-making process overall by lowering the number of variables that influence the choice. It is possible for him to make his final decision based primarily on one characteristic while disregarding the other considerations. This merely violates the continuity axiom, which states that a participant considers all attributes into choice (instead of only a subset of choices as in this case) and may lead to biased estimates. As one tends to consider more attributes when making decisions, the degree of ANA or overlooking of attributes tends to

increase as well, according to results from [Nguyen et al. (2015)], who suggested that the intensity of ANA deeply varies with the difficulty of the choice experiment. We chose the serial stated ANA method, in which we ask the participant for the factors he took into consideration when making his choice at the conclusion of each choice sub-task in our experiment. This method is one of many ways to measure and infer ANA from the results of the choice experiment, including serial-stated ANA, analytically deriving the non-attending attributes from the data, etc. Thus, through our experiment we aim to study the effect of attribute presentation on ANA, since presentation format of the attributes could impact the ANA and thus our WTP estimates.

C. Willingness to Pay (WTP)

WTP refers to the highest price a consumer is willing to pay for a product or service, and is typically represented in terms of prices or ratios to the original price of the item, acting as a suitable criterion for accounting the utility for the attributes. Because the choice experiments involve changing the attributes and their impact on the choices, the WTP is involved. Because the participant may be willing to pay more for the given attribute while ignoring the other attributes. This is thus an important factor for comparing the essential attributes and how varying the attribute value affects the price payable for the product, which could aid in developing an effective target strategy for consumers.

II. EXPERIMENT

For conducting the experiments we circulated a google form, which has been described below:

A. Participant Demographics

We collected the data from 76 participants, comprising of people from different age groups, of which majority being the college students from institutions across India. The graphs in fig(1) and fig(2) show the age distribution of the participants, and the graphs in fig(3) and fig(4) represent the gender distribution of the participants.

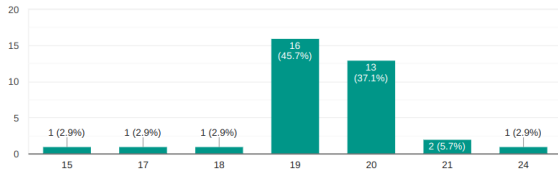


Fig. 1. Age Distribution for Visual Treatment

B. Design of the Experiment

We divided the given participants almost equally amongst the text and visual format treatment, with around 35 participants in the visual format and 41 in the text treatment. The original experiment involved one food item, and the

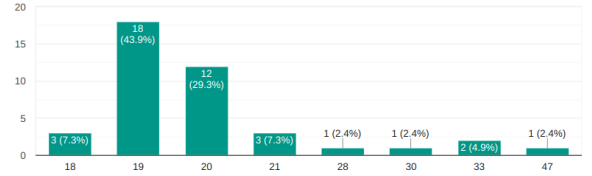


Fig. 2. Age Distribution for Text Treatment

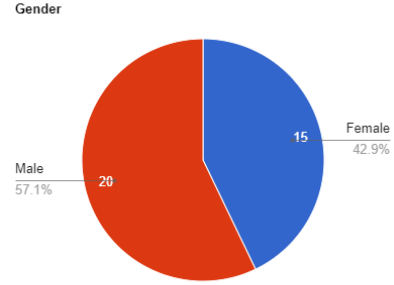


Fig. 3. Gender Distribution for Visual Treatment

two alternatives with varying attributes, provided to the participants. Our experiment was further divided into five subsections, each comprising of oil, butter, milk, juice and pulses. The participant could choose either of two alternatives for with varying attributes or none of them. The two alternatives A and B were designed in a way that the price of alternative A was always greater than alternative B. This choice was followed by a questionnaire that collected the major factors the participant accounted for while making the choices.

C. Questionnaire

The experiment consisted of two different questionnaires for textual and visual representation. A sample question from each of those questionnaires has been given below.

1) *Visual Treatment*: Following is the sample question given to the participants, wherein we represent the attributes visually through the designed images, making the features visually appealing to the participant.

2) *Text Treatment*: The same features represented in the text format were presented to the participants, and they were given the choice to choose from the alternative A or alternative B or neither of them, depending on their perception of the alternative and individual attribute preferences.

D. Indian Population

The original study included experiments with beef for their choice experiment, which thus is staple food item across the US population, which is not the case in Indian scenario. Thereby, we introduced the staple food items pertaining to India's domain like milk, oil, butter, pulses and juice so that majority of the population could consider themselves making

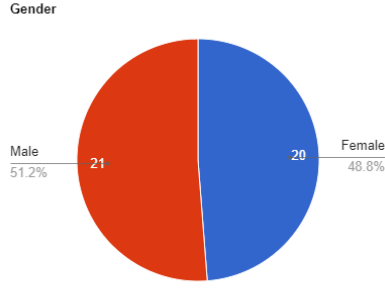


Fig. 4. Gender Distribution for Text Treatment

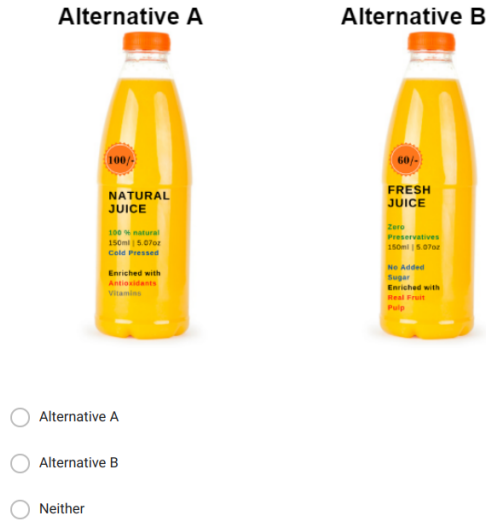


Fig. 5. Experiment Question for Visual Treatment

choice decisions in the actual market scenario rather than a hypothetical scenario.

E. Analysis

After finishing taking the survey and collecting all data, we applied several methods to gain various kinds information from the responses.

1) *Weights*: In order to be able to understand the difference between the alternatives for each product in both textual and visual treatments we try to calculate the utility of a participant by assigning weights to each attribute and generating a statistical model from it. Selecting these weights assigned to each attribute is really important and for that we make use of the data collected by the survey. Let us consider the weightage given to a particular attribute, assume **No Added preservatives** for the case of Milk. We shall write this as α_{iar} for some attribute index i , of alternative a for the product in the representation format r . To calculate this coefficient, we assume that its value will be the weightage

Alternative A *

- Rs 100
- Cold Pressed
- 100% Natural
- Enriched with Antioxidants and Vitamins

Alternative B

- Rs 60
- Zero Preservatives
- No added sugar
- Enriched with real fruit pulp

☐ Alternative A

☐ Alternative B

☐ Neither

Fig. 6. Experiment Question for Text Treatment

given to a particular attribute by an average participant in their decision making process. To understand the decision making of a participant, we ask them the attributes that factored into their decision making process while choosing that particular alternative. This data is then used to calculate the weighted frequency of each attribute for the particular alternative of the product.

We have called this weighted frequency because when a participant states that multiple attributes factored into their decision, we count a specific attribute's frequency from the list of attributes as the fraction of the number of total attributes that influenced their decision. In simpler terms let's say that a participant selects **Pasteurized Milk**, **Price** and **No added preservatives** influenced his decision making, then for each attribute stated, we shall count its frequency as:

$$\frac{1}{\text{Total Number of Attributes selected}}$$

So here the frequency for each attribute stated shall become 0.33. Then we calculate up total frequencies for each attribute and scale it between 0-1 by dividing these frequencies by their sum. Now this scaled value is the coefficient for a particular attribute. The calculated values of the coefficients for the product Milk have been added to the Tables I and II for Textual and Visual representation respectively.

2) *Utility*: We then calculate the utility of a participant i for Milk for the alternative a in representation format r using the below equation:

$$U_{iar} = -\alpha_{1ar}\text{Price}_{ar} + \alpha_{2ar}\text{Pasteurized Milk}_{ar} + \alpha_{3ar}\text{No Added preservatives}_{ar} + \alpha_{4ar}\text{Low Saturated Fat}_{ar} + \alpha_{5ar}\text{100\% pure}_{ar} + \alpha_{6ar}\text{Raw Unprocessed Milk}_{ar} + \alpha_{7ar}\text{Low in Cholesterol}_{ar} + \alpha_{8ar}\text{Raw Unprocessed Milk}_{ar} + \alpha_{9ar}\text{Same Creamy, Dairy Taste}_{ar} \quad (1)$$

Where, Price_{ar} is the Price of the alternative and **Pasteurized Milk**, **Low Saturated Fat** and other variables are

Product	Attribute	Coefficient
Milk Alternative A	Pasteurized Milk	0.391
	No Added preservatives	0.288
	Low Saturated Fat	0.25
	Price	0.089
Milk Alternative B	100% pure	0.235
	Price	0.197
	Same Creamy, Dairy Taste	0.235
	Low in Cholesterol	0.171
	Raw Unprocessed Milk	0.158

TABLE I
CALCULATED COEFFICIENTS OF MILK FOR TEXTUAL REPRESENTATION

Product	Attribute	Coefficient
Milk Alternative A	Pasteurized Milk	0.392
	No Added preservatives	0.317
	Low Saturated Fat	0.233
	Price	0.058
Milk Alternative B	100% pure	0.266
	Raw Unprocessed Milk	0.245
	Low in Cholesterol	0.211
	Same Creamy, Dairy Taste	0.169
	Price	0.1

TABLE II
CALCULATED COEFFICIENTS OF MILK FOR VISUAL REPRESENTATION

dummy variables that take the value one if the alternative specified that attribute and a value zero if it did not.

The α_{iar} used here are coefficients/weights calculated above with the help of participant responses. Note that, the negative sign in front of the price attribute thereby suggesting a negative correlation between the price of the good and the price, higher price would thus have less contribution to the overall utility.

3) *Willingness to Pay(WTP)*: The willingness to pay is an important metric in our experiment to be able to determine any difference between the visual and textual treatment of choice sets for different attributes of the products. For a particular product, the willingness to pay (WTP) of attribute i of the alternative a in the representation format r is calculated by the formula:

$$WTP_{ar} = \frac{\alpha_{iar}}{\alpha_{par}} \quad (2)$$

Where p indicates the *Price* attribute for the alternative.

III. RESULTS

After applying different metrics on the collected data, we obtained following results:

A. Attribute Non-Attendance

On analysing the stated attribute attendance for each participant for all of their choices, we calculated the percentage of people who did not attend to a certain attribute presented to them while making their choice. The results of non-attendance of the participants has been tabulated in Tables III and IV

Product	Alt.	Attribute	% ANA
Milk	A	Pasteurized Milk	25.0
		No Added preservatives	35.0
		Low Saturated Fat	55.0
		Price	85.0
	B	100% pure	33.33
		Raw Unprocessed Milk	41.66
		Low in Cholesterol	33.33
		Same Creamy, Dairy Taste	50
		Price	66.66
Juice	A	100% Natural	7.69
		Antioxidants and Vitamins	46.15
		Cold Pressed	76.92
		Price	84.61
	B	No added sugar	36.36
		Enriched with real fruit pulp	40.90
		Zero Preservatives	50.0
		Price	68.18
Pulses	A	Rich in Protein	31.25
		Organic	37.5
		Natural Oils Retained	75.0
		Price	68.75
	B	Iron and Vitamins	52.63
		Unpolished	21.05
		Natural Texture	52.63
		Price	63.15
Butter	A	Vitamin A,D,E & Omega 3	30.43
		Low Fat Content	34.78
		Price	91.30
	B	Natural Ingredients	41.66
		Low Cholesterol	41.66
		Creamy Texture	58.33
		Price	50.0
Oil	A	Vitamin A,D,E & Omega 3	26.66
		Cold Pressed	73.33
		Price	66.66
	B	Low Cholesterol	21.05
		Good for Heart	42.10
		Refined Oil	57.89
		Price	73.68

TABLE III
ATTRIBUTE NON-ATTENDANCE IN VISUAL REPRESENTATION FORMAT

Product	Alt.	Attribute	% ANA
Milk	A	Pasteurized Milk	30.76
		No Added preservatives	34.61
		Low Saturated Fat	46.15
		Price	76.9
	B	100% pure	23.07
		Raw Unprocessed Milk	46.15
		Low in Cholesterol	38.46
		Same Creamy, Dairy Taste	30.76
Juice	A	Price	53.84
		100% Natural	18.18
		Antioxidants and Vitamins	45.45
		Cold Pressed	45.45
	B	Price	90.9
		No added sugar	51.72
		Enriched with real fruit pulp	24.13
		Zero Preservatives	37.93
Pulses	A	Price	44.82
		Rich in Protein	28.00
		Organic	16.0
		Natural Oils Retained	64.0
	B	Price	88.0
		Iron and Vitamins	42.85
		Unpolished	28.57
		Natural Texture	71.42
Butter	A	Price	28.57
		Vitamin A,D,E & Omega 3	19.04
		Low Fat Content	28.57
		Price	80.95
	B	Natural Ingredients	35.29
		Low Cholesterol	41.17
		Creamy Texture	52.94
		Price	41.17
Oil	A	Vitamin A,D,E & Omega 3	10.0
		Cold Pressed	60.0
		Price	90.0
	B	Low Cholesterol	23.33
		Good for Heart	13.33
		Refined Oil	80.0
		Price	60.0

TABLE IV

ATTRIBUTE NON-ATTENDANCE IN TEXTUAL REPRESENTATION FORMAT

The percentage attendance to the price attribute in Textual and Visual format has been compared in Table V. From this table, we can infer that more % of participants attended to the price attribute when the alternatives were provided in Textual treatment as compared to Visual treatment. A reasoning behind this could be that people were influenced by the distracting

Product	% Attendance	
	Visual	Textual
Milk	21.87	30.76
Juice	25.71	42.5
Pulses	32.28	34.11
Butter	22.85	36
Oil	29.41	32.5

TABLE V

% PARTICIPANTS ATTENDING TO THE PRICE ATTRIBUTE OF THE PRODUCTS IN BOTH TREATMENTS

effect of the images while making the choices in the visual format of the experiment.

B. Utility

We determine the utility of each person for all of the choices they made using (1). Also, it is to be noted that we are not considering the utility of a participant who selected neither as their preference as it would be very low compared to the participants who selected either one of the alternatives A and B.

Product	Alternative	Mean Utility	
		Visual	Textual
Milk	A	0.91	1.30
	B	1.57	3.36
Juice	A	2.27	0.91
	B	4.14	8.71
Pulses	A	13.14	1.71
	B	13.02	36.35
Butter	A	1.20	2.23
	B	6.58	8.38
Oil	A	13.91	2.71
	B	5.39	9.61

TABLE VI

AVERAGE UTILITY FOR EACH ALTERNATIVE OF ALL 5 PRODUCTS

The mean utility of all participants for each of the product's alternatives has been shown in Table VI. From this table, we can easily observe that the mean utility for the **Alternative B** of all products is significantly lesser in visual treatment as compared to textual treatment. This tells us that the user's who go for the cheaper alternative, i.e. alternative B, usually have more utility or in other terms they have a higher tendency to choose this alternative in textual format as compared to the visual format of representation.

C. Willingness to Pay (WTP)

The willingness to pay for each attribute was calculated using the formula described in eq. (2). The values obtained for each attribute in for both alternatives of the products in visual as well as textual format have been tabulated into Tables VII and VIII. The WTP values here are ratios of the coefficients and are not scaled to the actual price of the product.

Product	Alt.	Attribute	WTP
Milk	A	Pasteurized Milk	6.71
		No Added preservatives	5.42
		Low Saturated Fat	4.0
	B	100% pure	2.49
		Raw Unprocessed Milk	2.29
		Low in Cholesterol	1.97
		Same Creamy, Dairy Taste	1.58
Juice	A	100% Natural	5.62
		Antioxidants and Vitamins	2.25
		Cold Pressed	4.0
	B	No added sugar	1.59
		Enriched with real fruit pulp	1.52
		Zero Preservatives	1.16
Pulses	A	Rich in Protein	1.60
		Organic	1.46
		Natural Oils Retained	0.39
	B	Iron and Vitamins	0.74
		Unpolished	1.69
		Natural Texture	0.71
Butter	A	Vitamin A,D,E & Omega 3	7.66
		Low Fat Content	6.66
	B	Natural Ingredients	1.89
		Low Cholesterol	1.21
		Creamy Texture	0.86
Oil	A	Vitamin A,D,E & Omega 3	3.16
		Cold Pressed	0.83
	B	Low Cholesterol	3.61
		Good for Heart	2.30
		Refined Oil	1.84

TABLE VII
WILLINGNESS TO PAY IN VISUAL REPRESENTATION FORMAT

Product	Alt.	Attribute	WTP
Milk	A	Pasteurized Milk	4.14
		No Added preservatives	3.21
		Low Saturated Fat	2.78
	B	100% pure	1.19
		Raw Unprocessed Milk	0.87
		Low in Cholesterol	0.80
		Same Creamy, Dairy Taste	1.19
Juice	A	100% Natural	13.50
		Antioxidants and Vitamins	11.0
		Cold Pressed	7.5
	B	No added sugar	0.76
		Enriched with real fruit pulp	1.32
		Zero Preservatives	1.0
Pulses	A	Rich in Protein	7.85
		Organic	9.71
		Natural Oils Retained	2.85
	B	Iron and Vitamins	0.6
		Unpolished	0.93
		Natural Texture	0.26
Butter	A	Vitamin A,D,E & Omega 3	6.40
		Low Fat Content	5.2
	B	Natural Ingredients	1.22
		Low Cholesterol	1.35
		Creamy Texture	0.95
Oil	A	Vitamin A,D,E & Omega 3	6.99
		Cold Pressed	2.0
	B	Low Cholesterol	2.56
		Good for Heart	3.19
		Refined Oil	0.44

TABLE VIII
WILLINGNESS TO PAY IN TEXTUAL REPRESENTATION FORMAT

From the data shown in these tables, we can say that the WTP for **Juice, Pulses and Oil** is lesser in Visual representation as compared to Textual representation. However, for the case of **Milk**, we observe that the willingness to pay is more in Visual representation. This is an interesting observation as this enables us to explore the possibility of difference in decision making of users for some products as compared to others in different formats of representation.

IV. LIMITATIONS

1) **Position of the Labels:** : Another potential limitation of our study is that we did not change the order of the attributes displayed in the Text Treatment or the position of the labels on the package in the Visual Treatment. In particular, in our Text Treatment, the price attribute was listed first, while in the visual treatment, it was shown below the type of feed attribute. When accounting for ANA, this may result

in ordering effects and impact preferences [7]. However, [8] tested this by looking at whether attributes neighboring other attributes affected visual attention using correlation analysis. They found only low to medium correlations for ANA based on the attributes' positions in the choice sets.

2) **Price Bias in Utility Function:** The coefficient of our price attribute in our utility function is the price of the product itself, which creates a significant bias because price can be very large in comparison to the coefficients of the other attributes (which are boolean, i.e. 0 for absent or 1 for present), and thus the higher bias w.r.t the price attribute while calculating the utility.

3) **Age Group:** The age isn't well distributed across the participants, with majority being from the higher education students, and thus could impact their decision making process due to their limited and varying spending power.

4) **Presentation Format:** : We only tested two presentation formats in this study: a table format with only text and a visual/picture format with only labels, [5] tested whether a table format containing part text and part labels leads to different results than tables with text only versus pictures only. They discovered that participants in the picture and text-table treatments preferred attributes with high visual salience more. Their study, however, was conducted for landscapes, which differs from a food product that carries the actual attributes.

V. ACKNOWLEDGMENT

This report is based on the reference from the study [6]. We would like to thank Prof. Kavita Vemuri, Cognitive Sciences Lab, IIIT-Hyderabad, for her constant feedback and support throughout the project, as well as for providing many valuable insights on the project that aided in its completion.

VI. CONCLUSION AND FUTURE WORK

The choice of format and presentation of the attributes has not received much attention in the literature, but there is a significant difference in the perception of the attributes in both treatments. According to the experiment results, the WTP estimates for the text treatment were higher than those for the visual treatment in the case of juice, pulses, and oil, as shown in tables VII and VIII. As a result, the WTP estimate could be affected by the product being used. In future studies, the effects of text placement, font size variation, and label arrangement could be investigated. The current study ignores text label positioning, with (say) the price attribute appearing first in all text treatments. The positioning of the attributes could be investigated and analysed.

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