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ALLISON AND UHL REVISITED: BEER BRAND DISCRIMINATION USING TASTE AND AROMA CUES

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#587

College of Commerce and Business Administration
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Summary:

A 2^3 split-plot factorial experiment was conducted to assess the effect of brand information, product familiarity, and order of presentation on consumers' judgements of the taste of beer samples. Paired comparisons on several taste characteristics and preferences served as dependent variables. Subjects were 240 college students. The results suggest that beer drinkers can distinguish among brands using taste and aroma cues alone. These findings are explained and compared with the pioneering study of Allison and Uhl.

ALLISON AND UHL REVISITED:

BEER BRAND DISCRIMINATION USING TASTE AND AROMA CUES

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Allison & Uhl Revisited:

Beer Brand Distrimination Using Taste and Aroma Cues

Introduction

It is frequently asserted that beer drinkers are unable to discriminate among brands of beer using only taste and aroma cues. If true, this would imply that beer drinkers must rely on extrinsic cues (e.g., brand name, price, store image) to decide which brand of beer to purchase, because they cannot make use of intrinsic cues (e.g., product taste or aroma). However the empirical support for this claim is somewhat mixed. Only three published studies can be found in the marketing literature which have directly addressed this question(Allison and Uhl, 1964; Jacoby, Olson and Haddock, 1971; Valenzi and Eldridge, 1973).

Allison and Uhl's pioneering work 1964 tested the principal hypothesis that: "Beer drinkers cannot distinguish among major brands of unlabeled beer either on an overall basis or on selected characteristics." Following their field work, using five brands of beer which were well known in the market, the writers concluded that: "Participants in general, did not appear to be able to discern the taste differences among the various beer brands, but apparently labels, and their associations, did influence their evaluations. In other words, product distinctions or differences, in the minds of the participants arose primarily through their receptiveness to the various firms' marketing efforts rather than through perceived physical product differences."

Recent studies however have not consistently supported Allison and Uhl's findings. Valenzi and Eldridge (1973) found similar results, while another study did not (Jacoby, Olson, and Haddock, 1971). Failure to find significant differences may be due to methodological shortcomings rather than to people's inherent inability to discriminate. Close examination of these three studies supports this conjecture. The only study which found that subjects could discriminate systematically among beer brands, using only taste and aroma cues, employed the most rigorous experimental methods (Jacoby, Olson and Haddock, 1971). Specifically, this study differed in two critical ways from the others: (a) it included the full range of beer brands available in the marketplace while the other two studies sampled only a limited range of brands, and (b) it employed very sensitive measurement procedures while the others used much cruder measures.

Clearly, people will be more likely to be able to discern differences among stimuli the greater the natural variation there is among the stimuli. Almost everybody should be able to tell pure alcohol from pure water using only taste and aroma cues, but it may be more difficult to discriminate reliably between Olympia and Coors. The important question for marketers is whether or not people can discriminate among beer brands normally found in the marketplace. If they can, then marketers must recognize this fact in their advertising.

Equally important is the selection of measurement procedures. While market researchers routinely use the method of single stimuli (i.e., methods where the subjects rate each stimulus one at a time), this may not be the most appropriate technique to use in all situations. Allison and

Uhl's original hypothesis was that beer drinkers cannot distinguish among major brands using only taste and aroma cues. This is a claim about people's ability (or lack of ability) to discriminate. Since discrimination, by definition, refers to the task of comparing two or more stimuli directly with each other, noting similarities or differences, the most appropriate measurement technique would be a comparison technique such as paired comparisons or a triangle taste test (Amerine, Pangborn, and Roessler, 1965). The method of single stimuli is inappropriate because stimuli are not directly compared with each other. If beer drinkers can taste the differences, they would be likely to base their selection of beer brands in the marketplace on the taste of the product rather than on just external information.

It thus appears worthwhile to reconsider the principal hypothesis of the Allison & Uhl study using more appropriate measurement techniques, such as paired comparisons, and including the full natural range of beer brands available in the market place.

It is worth noting that these studies differ in their choice of dependent variables. Allison & Uhl measured a variety of taste characteristics (e.g., strength, body, bitterness), as well as a general quality rating. Later researchers have focused primarily on perceived quality (Olson, 1977). There are advantages to studying descriptive taste characteristics rather than perceived quality. First, descriptive characteristics allow more scope for marketing control. They are more "actionable" in that such characteristics are particularly useful in positioning new products (Green, 1975; Stefflre, 1968). Second, it seems plausible that

differences between brands may be more readily identified using descriptive characteristics than with perceived quality due to the more "available" or more "codable" nature of descriptive characteristics (Brown & Lenneberg, 1954; Lanz & Stefflre, 1964).

In addition, using perceived quality ratings alone, it is not possible to differentiate between cases where a subject cannot distinguish between two beer samples, and cases where the samples can be distinguished, but are considered to have the same level of quality.

A secondary concern in this paper is to look at the effect of consumer familiarity with the product class on taste judgements. Several researchers have suggested that consumers' perceptions of a product class may differ with their degree of familiarity with the product (Olson, 1977; Shapiro, 1968). Perhaps people who drink beer only occasionally, and thus are less familiar with the product class, are less able to discriminate among the various brands using only taste and aroma cues.

The objectives of this study are to: (a) examine to what extent the perception of, and preference for, beer samples is influenced by brand information; (b) determine by which taste characteristics (if any) beer drinkers can distinguish among brands of beer, using only taste and aroma cues; (c) determine to what extent familiarity with the product class influence drinkers' ability to distinguish among brands of beer.

Method

Stimuli

The full range of popularly purchased brands of beer that are

normally available in the market in British Columbia, were included in this study. This entailed nine different brands of beer. Six were Canadian and three were American. There were three light lagers, four lagers, and two ales. All of the Canadian brands normally retail for the same price while the American brands retail for a slightly higher price. While the brands were selected to reflect the full variety of product that was available to the consumer, all brands of beer were approximately the same color. No dark beers were included in the study.

Subjects

A convenience sample of 240 subjects was drawn from a population of volunteer undergraduate and graduate students. Subjects had to be at least nineteen years of age, and admit to drinking at least "some" beer, to quality for inclusion in the study. Twenty-seven percent of the subjects in each experimental condition were female. College students were used in this study because they are an important submarket for the beer industry, as well as being standard subjects for experimental research.

Design

A 2^3 factorial experiment with one repeated measure factor was conducted with sixty subjects per cell. The repeated measure factor was Label (brand name present or absent). The between-subject factors were Familiarity (high or low) and Order of Presentation (straight or inverse).

The Label factor involved presenting samples of the same brands of beer to subjects under different conditions. On the first presentation, samples were identified by brand name; on the second, only three-digit code numbers were used. All code-numbers were screened in order to eliminate any meaningful triples (e.g., 747). All subjects received the samples in the same order.

For the Familiarity factor, subjects were classified as having a high degree of familiarity with the domain, if they drank six or more bottles of beer per week; or as having a low degree of familiarity with the domain, if they drank five or fewer bottles per week. This break point was determined by a reference to the practice of Canadian brewers, Labatt and Molson, in consumer panels.

To obtain two levels for the Order of Presentation factor, both the sequence in which pairs were presented to the subjects, and the order of samples within the pairs, were reversed.

Subjects were randomly assigned to oneof two experimental conditions. One-half of the subjects received a pre-selected order of pairs of beer samples and samples within pairs, while the other half of the sample received the beer samples in the inverse order. For example, the sequence: 'Olympia-Schlitz; Lite-Cool Spring; Old Style-Export Ale' was presented to half of the sample, while its inverse, 'Export Ale-Old Style; Cool Spring-Lite; Schlitz-Olympia' was given to the other half of the subjects.

The dependent variables were:

(a) the perceived similarity of the pair of samples, where the judgement of similarity was expressed using a nine-point scale on which "one" indicated "dissimilar" and "nine" indicated "very similar";

(b) preference within the pair of samples;

(c) judgements within the pair of samples, as to which exhibited "more" of each of several taste characteristics (i.e., strength, lightness, aftertaste, bitterness, carbonation, heavy bodiedness, fillingness, and smoothness).

For (b) and (c) the dependent variables were dichotomous choices. No "undecided" responses were permitted.

There are thirty-six possible ways to pair each of nine brands. If the nine identity pairings are included also, there is a total of forty-five distinct pairings. An identity pairing is a pairing where a sample is paired with itself. Fifteen blocks of three distinct pairs each were fashioned in order to present all forty-five of these pairs in the Blind condition (brand name absent). Careful attention was paid in assigning pairs to blocks to ensure that no block contained more than two examples of any one brand. This was not possible in the nine blocks containing the identity pairings. In those blocks which did include more than one of the same brand, it appeared on the left as often as in the right. In no block did the same beer appear in all three pairs. In the Branded condition, the nine identity pairs were replaced by nine other pairs respecting the same assignment considerations as in the Blind condition. All fifteen of these blocks were replicated four times in each of the eight experimental conditions, giving sixty subjects per cell.

Procedure

Each subject tasted a total of six pairs of beer samples. Each received three unlabeled beer pairs first, followed by three labeled beer pairs. Each sample of beer consisted of one ounce of liquid. The subjects were requested to nibble unsalted crackers after tasting each pair of beer samples in order to cleanse the palate.

In order to minimize demand artifacts in the study, subjects were told that the unlabeled beer samples were not the same as the labeled samples. The unlabeled samples were described as potential new products

which were being evaluated prior to introduction to the B.C. market. Interviews with selected subjects after the study indicated that they were not aware that the same samples had been involved in both conditions.

After tasting each pair of samples, subjects were requested to indicate their impressions on each of the dependent measures. Subjects were first requested to rate the perceived similarity of the stimuli, and then to indicate which of the two stimuli they preferred. Then the subjects judged the samples on each of the eight taste characteristics. The characteristics were presented to subjects in sixteen distinct orderings, to minimize the influence of any possible fatigue effect on the results.

These sixteen orderings consisted of all one-step permutations of a preselected order and its inverse. Each subject was presented with a different ordering of the eight taste characteristics for each of the six pairs of beers he was asked to judge. Thus subjects received three permutations from each of the two basic orders in alternation, so that a pattern was not readily apparent in the presented orderings.

Careful attention was paid to presenting all beer samples under identical conditions: the temperature was kept at 39 degrees F (4 degrees C), bottles and cans were opened and poured immediately before being offered to subjects, and the beer samples were carefully poured in a manner that would not create a frothy head.

Results

A split-plot ANOVA design was used to analyze the data because of the

repeated measure factor (Label). Two 2-way ANOVAs were conducted to examine the effect on the dependent variables of the independent variables of Label, Familiarity, and Order. Two 2-way ANOVAs were conducted rather than one 3-way ANOVA in order to have a sufficient number of subjects per cell (eight) for each pair of beer samples [Kirk, 1968, pp.245-318].

Each of the thirty-six pairs of the nine brands of beer may be seen as a separate split-plot factorial experiment. Since subjects made dichotomous choices between brands, these results were treated as dummy-variable data and analyzed using a standard ANOVA routine [Neter & Wasserman, 1974, Chapter 8)[1].

In order to examine the effect of the independent variables for the entire set brands included in the study, the ANOVA results for each of the dependent variables were summed across all of the thirty-six pairs. As in the standard ANOVA design, significance may be determined by using an F-test. The appropriate degrees of freedom for the overall F-test is the sum of the degrees of freedom for each of the individual F-tests.

Table 1 shows the results of the first two-way split-plot ANOVA for the Familiarity and Label factors for the subjects' overall preferences for the nine beer brands. Neither of the main effects, nor the interaction effect, is significant at the .01 level.[2] This indicates that beer drinkers retain the same overall preference for beer brands in taste tests with or without brand information. These results imply that beer drinkers are able to discriminate as well (or as poorly) in taste tests with or without brand information. In addition, frequent beer drinkers do not differ appreciably from occasional beer drinkers in their preferences.

Table 2 shows the results of the second two-way ANOVA for subjects' preferences in which the Familiarity factor has been replaced by the Order factor. Again, neither of the two main effects is significant, nor is the interaction effect. This provides support for the previous ANOVA results for the Label effect, and implies that the order of presentation of the stimuli did not play an important role in determining subjects' preferences.

Insignificant ANOVA results may be due to excessive noise in the data, as well as due to the same patterns emerging under both conditions. To investigate the patterns of discrimination among the brands, the perceived similarities of the samples were scaled for both conditions of the Label factor (labeled, unlabeled) using TORSCA-9B (Young & Torgerson, 1967). Figure 1 compares the results of these two analyses. The unlabeled configuration has been rotated to a least squares fit with the labeled configuration (Pennell & Young, 1967). While the beer brands are tightly clustered in the labeled configuration, they are more widely scattered in the unlabeled configuration. Nevertheless the same two basic groupings may be identified in both configurations:

Cluster I: Olympia, Schlitz, Lite, and Cool Spring.

Cluster II: Old Style, Export Ale, Canadian, Blue, and 50 Ale

Cluster I contains the lighter and smoother beers, while Cluster II consists of stronger and heavier beers. All of the American beer brands are in Cluster I, which also contains one Canadian brand (Cool Spring). When the vertical line in Figure 1 divides the configurations into these

two clusters, only two of the unlabeled beers are misclassified (Olympia and 50 Ale). Olympia was seen as being heavier when unlabeled than it was when labeled, while 50 Ale was seen as being lighter unlabeled than it was when labeled.

In a parallel manner to the analyses of preference, two-way split-plot ANOVAs were conducted for each of the remaining dependent variables, the eight taste characteristics. Tables 3 and 4 show the F-values for these analyses. Neither the Order effect not the Familiarity effect was significant for any of the taste characteristics. It appears that for the set of measures included in this study, both occasional and frequent beer drinkers agree about the taste of beer. Moreover, the order of stimulus presentation does not play an important role in any of these dependent variables.

There was a significant Label effect for four of the eight taste characteristics. The introduction of brand information appears to have altered consumer perceptions of beer strength ($F = 2.13$, $p < .01$), lightness ($F = 2.49$, $p < .01$), heavy bodiedness ($F = 2.28$, $p < .01$), and fillingness ($F = 1.78$, $p < .01$). Interestingly enough, brand information did not seem to influence perception of aftertaste, bitterness, carbonation, nor smoothness, for these beer brands. This implies that subjects were able to distinguish among brands using only taste and aroma cues as well as they could with brand information.

Only one of the interaction effects was found to be significant, that of Familiarity x Label ($F = 1.71$, $p < .01$). This interaction was also found to be significant by Valenzi and Eldridge (1973).

How robust are these results considering that the paired comparisons are not strictly independent with respect to each other, as every brand of

beer is compared with every other one? To attempt to answer this query, the ANOVA's were recalculated omitting, one at a time, each of the nine brands. Not one of the previously significant effects was now insignificant, nor were any of the previously insignificant effects now significant. This suggests that these results were not an artifact of the lack of independence.

It is also possible that the 2-way ANOVA's used in this study did not find significant effects because the sums of squares has been collapsed too far by including variance attributable to the effect of the third factor in the error terms. To evaluate the importance of this potential problem, the preference measure, which was not significant but was quite close, was re-analyzed using a 3-way ANOVA design. None of the main effects were found to be significant at the .01 level, although the Familiarity x Label interaction effect was found to be significant as it was in the 2-way analysis ($F = 1.77$, $p < .01$). None of the other measures would be expected to yield different results if re-analyzed using a 3-way ANOVA.

That the Label factor was significant in four out of the nine measures, suggests that brand information influences certain taste characteristics, but not others. This is probably due to the information associated with the brand image, which pertains to some specific taste characteristics but not to others. These results are consistent with the often heard claim that American beers are lighter, and have a lower alcohol content, than Canadian beers. However, certain Canadian beers (e.g., Cool Spring and Blue) are judged from taste and aroma to be as light as some American brands (e.g., Schlitz and Olympia).

To investigate the interrelationships between the measures with respect to the two levels of the Label factor, each of the taste characteristics and overall preference were scaled using Thurstone paired-comparison techniques, and the resulting one-dimensional scales intercorrelated (Torgerson,1958). These intercorrelations were then themselves used as input to TORSCA (Young & Torgerson, 1967). Figure 2 shows the pattern of relationships among the eighteen resulting Thurstone scale (nine for each of the two conditions). Note that the scales cluster quite tightly in two distinct groupings along the same dimension as seen in Figure 1. The two preference scales and, to a lesser extent, the two carbonation scales are exceptions. Note also that both the labeled and unlabeled versions of each scale are located very close to each other, with the striking exceptions of the preference and carbonation scales. This provides corroboration for the ANOVA results: the subjects judge the beer samples in the same manner with or without brand information.

Discussion

In sharp contrast to Allison and Uhl's study, the results of this study suggest that beer drinkers can distinguish among major brands of beer using only taste and aroma cues. Beer drinkers were able to discriminate among brands using four of the taste characteristics -- smoothness, carbonation, bitterness, and aftertaste — in the absence of brand information.

It would be unrealistic to expect beer drinkers to be able to use all of the taste dimensions that might be concocted by researchers. What is

striking, is that subjects were able to discriminate among the beer samples on any of the taste characteristics. In fact, subjects performed nearly as well in the unlabeled condition as they did in the labeled condition. Moreover, their preferences did not change significantly between unlabeled and labeled conditions. If these conclusions may be generalized, the typical beer drinker's abilities to discriminate among brands may put a definite limit to advertiser's power to influence product evaluations using extrinsic cues (e.g., brand name, price, store image).

This study differs from Allison & Uhl's pioneering study in several ways methodologically: any one of which might be sufficient to explain the contrasting results. Table 5 characterizes briefly the approaches taken in both of these studies.

These differences fall naturally into three categories: (a) the range of stimuli included, (b) experimental methods employed, and (c) the subject population selected. The critical aspects of each of these will be discussed in turn.

First, the stimuli in this study were selected to reflect the natural variation of beer brands available in the market place, while Allison & Uhl limited their attention to brands which were quite similar to each other. The original Allison and Uhl paper specified that they had used the five brands among which "there were some taste differences discernible to expert taste testers". But in a retrospective comment which accompanied a reprint of the paper, the authors explained that the five brands were "basically undifferentiated" products, because they chose beer brands which because of their similarities, provided the main competition for one of

their sponsor's beer brands (Allison & Uhl, 1977).

As the range of taste differences was greater in this study than in Allison and Uhl's study, subjects would be more likely to be able to distinguish among the product samples using taste and aroma cues along (Amerine, et al, 1965). These data suggest that beer drinkers are able to discriminate among beer brands using taste and aroma cues, although they may not be able to discriminate subtle differences. For example, only two clusters of beers were identified here: lighter and smoother brands were distinguished from heavier and more bitter brands. Advertising and label effects may be limited to influencing beer drinkers perceptions of beers within such clusters.

The second way in which these studies differ is in the experimental methods employed. Two of these differences are probably the most important and need to be discussed: (a) the experimental design of the studies, and (b) the measurement methods. Allison and Uhl conducted a field study, which used only crude controls, while the present study was a laboratory experiment, involving tight controls on the tasting situation. Allison and Uhl designed their study to obtain maximum external validity -- ability to make inferences beyond the specific subjects, to beer drinkers in general -- by minimizing the intrusion of the experiment into the subjects' normal beer drinking behavior. Thus their samples were 12-ounce brown bottles (with labels soaked off and the crowns wire brushed for the unidentified tests) which were left at subjects' homes to be drunk and rated at the subjects convenience. While this provided no control over how the samples were rated -- and so sacrificing internal validity -- it

should have achieved reasonable external validity.

In addition, different methods of measuring the dependent variables were used. Paired comparisons were involved in this study, while Allison and Uhl used the method of single stimuli. The tasks required for subjects differ considerably for these two types of methods. Paired comparison relies on the comparison of two or more stimuli, while the method of single stimuli involves naming or rating stimuli individually. Paired comparison methods are generally considered to be more sensitive to existing differences than is the method of single stimuli. Indeed, as the previously mentioned retrospective comment by Allison and Uhl pointed out, within some commercial organizations, a triangle taste test with subjects sampling from three containers, two of which contain identical beverages, offers a better procedure and resulting data set for many taste perception situations.

It would not be surprising if beer drinkers were able to discriminate among beer brands rather well, but were not able to attach labels reliably to brands or to successfully identify their favorite brand from out of a set of similar alternatives. However, recent work suggests that the general public may be able to identify a wide range of commonly encountered substances using only aroma cues under reasonable circumstances (Cain, 1979).

Finally, the studies were based on different subject populations: Allison and Uhl sampled adult beer drinkers in the Midwestern U.S., while this study used a convenience sample of Canadian college students.

Sample difference may be important as other studies have found that

students differ from the general population in important respects (Park & Lessig, 1977).

It is difficult to generalize from these studies to the behavior of beer drinkers in general. Are consumers able to discriminate between brands of beer using only taste and aroma cues? Perhaps the conclusion of this study, that beer drinkers can discriminate, is only a "hot-house flower" which cannot be replicated outside of the laboratory. The authors of this study disagree about the generalizability of the conclusions. One of us doubts that it can be; the other thinks that the conclusions may be generalized to the behavior of beer drinkers in the marketplace. A field study, similar to the original Allison and Uhl effort, needs to be conducted using paired comparison methods to examine adult beer drinkers' powers to discriminate across the full range of brands naturally available in the marketplace.

FOOTNOTES

1. Alternative approaches have been developed by Bechtel (1967) and Scheffé (1952) for analyzing paired-comparison data. However, these approaches have the subjects rate the similarity of each pair of stimuli rather than having subjects select the X'er stimulus as in my study.
2. The .01 significance level was selected for use in this study as it is appropriately conservative considering the large number of tests of significance that had to be calculated. If the series of tests for each effect across the nine measures is considered as an "experiment", this gives a probability of .086 that at least one of these nine tests would be significant at the .01 level. More striking still is that for the entire series of 27 significance tests, there is a probability of 0.24 that at least one test is significant by chance alone at the .01 level (Kirk, 1968, Chapter 2).

TABLE 1

Label and Familiarity Effects for Preference Measure

Source	Subjects	df	MS	F
Between subjects	139.504	540		
Familiarity	11.121	36	.309	1.212
Subj. w/groups	128.383	504	.255	
Within subjects	131.000	576		
Label effect	11.621	36	.323	1.531
Label x Familiarity	12.996	36	.361	1.711*
Label x subjects	106.383	504	.211	
Total	207.504	1116		

* An F-value of 1.675 is needed for an effect to be significant at the 0.01 level with (36,504) degrees of freedom.

TABLE 2

Label and Order Effects for Preference Measure

Source	Subjects	df	MS	F
Between subjects	139.504	540		
Order effect	8.371	36	.232	.892
Subj. w/groups	131.133	504	.260	
Within subjects	131.000	576		
Label effect	11.621	36	.323	1.448
Label x Order	6.996	36	.194	.870
Label x subjects	112.383	504	.223	
Total	270.504	1116		

* An F-value of 1.675 is needed for an effect to be significant at the 0.01 level with (36,504) degrees of freedom.

TABLE 3

Summary of F-Values for Two-Way ANOVA's Across All Measures for Familiarity and Label Effects

Measure	Familiarity	Label	F x L
Preference	1.21	1.53	1.71*
Strength	0.59	2.17*	0.94
Lightness	1.20	2.49*	1.05
After taste	1.13	1.15	1.19
Bitterness	1.37	1.29	1.20
Carbonation	1.02	0.99	0.95
Heavy Bodiedness	0.58	2.35*	1.18
Fillingness	1.02	1.80*	0.92
Smoothness	1.07	1.04	1.19

* An F-value of 1.675 is needed for an effect to be significant at the 0.01 level with (36,504) degrees of freedom.

TABLE 4

Summary of F-Values for Two-Way ANOVA'S Across All Measures for Order and Label Effects

Measure	Order	Label	O x L
Preference	0.89	1.45	0.87
Strength	0.80	2.13*	0.71
Lightness	1.30	2.60*	1.53
After taste	1.08	1.13	0.90
Bitterness	0.91	1.27	0.96
Carbonation	1.29	1.02	1.24
Heavy Bodiedness	0.82	2.28*	0.77
Fillingness	1.22	1.78*	0.83
Smoothness	0.95	1.03	0.95

* An F-value of 1.675 is needed for an effect to be significant at the 0.01 level with (36,504) degrees of freedom.

TABLE 5

A Summary of the Methodological

Differences Between the Two Studies

	Allison and Uhl	Mauser
Stimuli	Restricted range, very similar brands.	Full range of popular brands in the marketplace.
Subjects	Adult beer drinkers.	College students.
Tasting Environment	At home, or at drinker's discretion	In experimental laboratory.
Beer sample size	12-ounce bottle	1-ounce.
Tasting sequence	At drinker's discretion.	Determined by experimenter.
Time of tastings	At drinker's discretion within a oneweek period.	One after the other, within one-half hour.
Standard tasting Procedure	None.	Cleansed palate. Controlled temperature. Poured without a head immediately before tasting.
Time of rating relative to time of tasting	At drinker's discretion, but during the same one week period.	Immediately after tasting each pair of beers.
Measurement methods	Identification task, three-point rating scales.	Discrimination task, dichotomous choice.

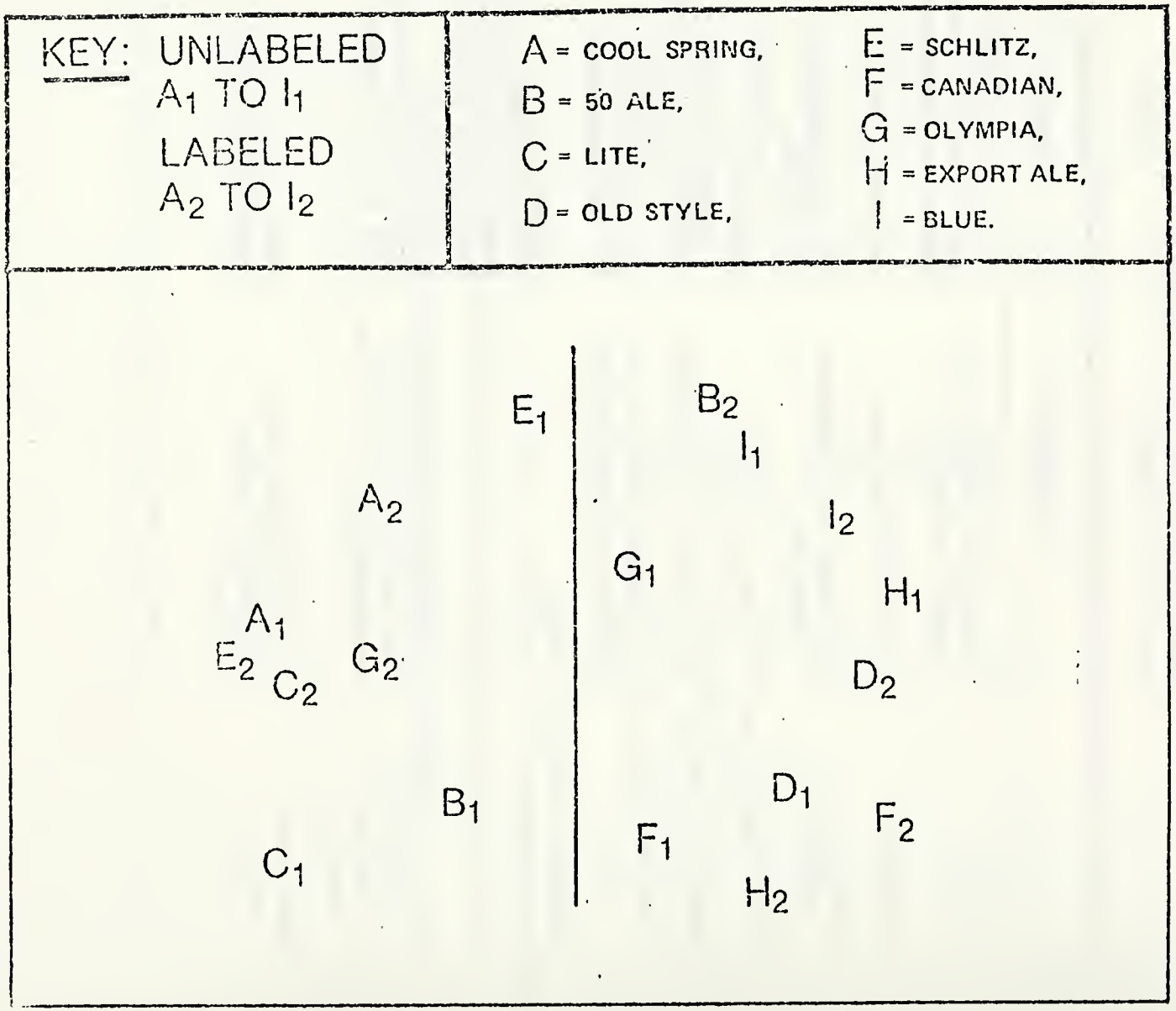

Fig. 1. Comparison of two - dimensional TORSCA solutions for beer brands under unlabeled conditions (stress = .126), and labeled conditions (stress = .185)

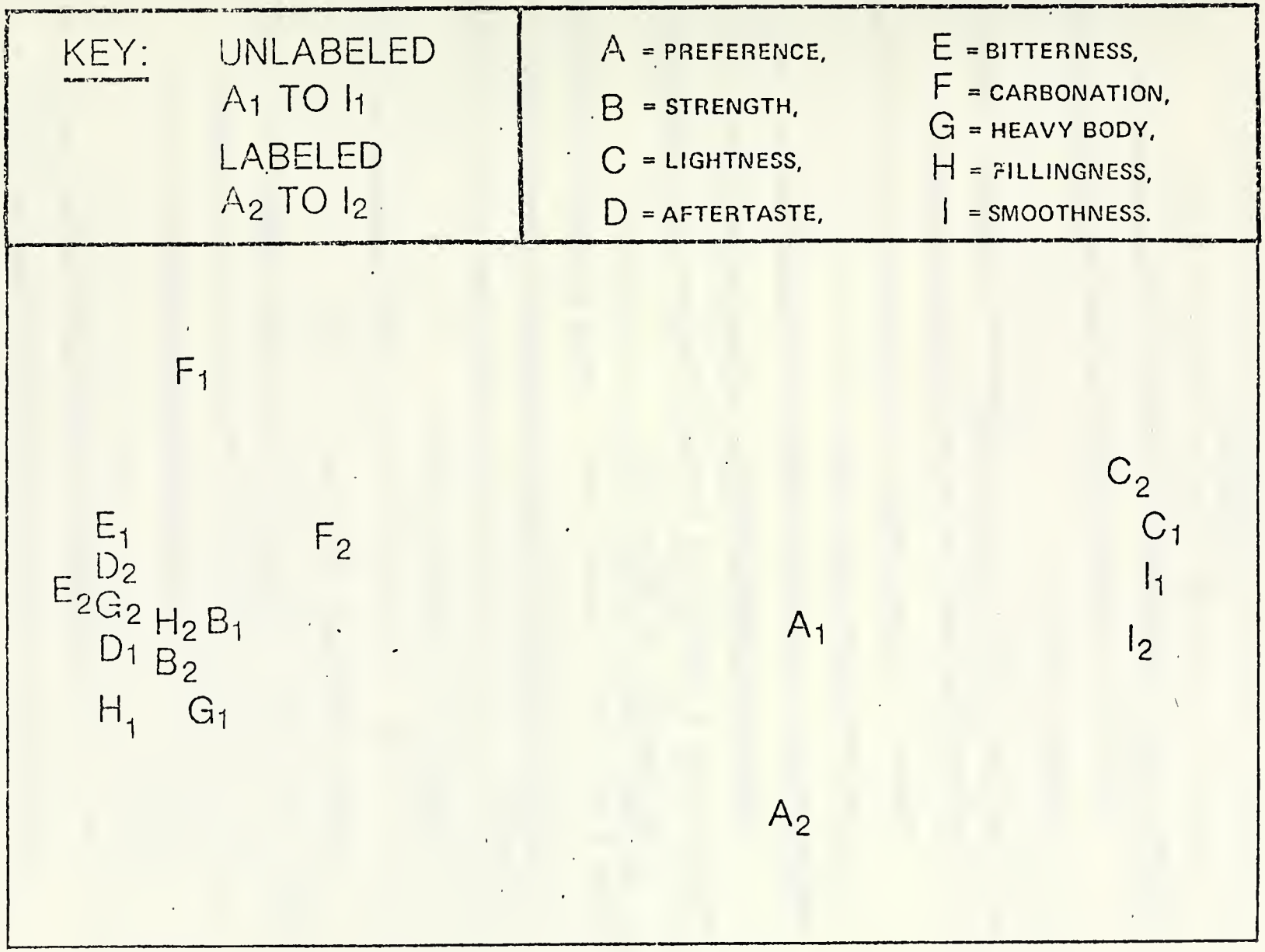

Fig. 2. Two dimensional TORSCA solution (stress = .056) for Thurstone scales intercorrelated across beer brands under unlabeled and labeled conditions.

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