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A field study comparing online and offline data collection methods for identifying product attribute preferences using conjoint analysis

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Abstract

Do online and offline data collection methods yield different attribute preferences in an importance-rating task and a choice-based conjoint analysis task? This question is addressed in a field study designed to identify promising attributes for a new generation of wireless telephone handsets in an actual product development context. No practical differences in attribute preferences were observed between data collection methods when attribute preferences were measured using a direct importance-rating question. However, significant differences in attribute preferences were observed between the methods in the choice-based conjoint analysis task. Moreover, the online data collection method was judged superior to a traditional offline (paper-and-pencil) method on the basis of internal consistency and predictive (face) validity. These findings support the use of Internet/Web-enabled technology for conjoint analysis data collection. Other implications for research practice are discussed.

Keywords: Conjoint analysis; Product development; Research methodology; Internet/Web-enabled data collection

1. Introduction

Online market research using Internet/Web-enabled technology has captured the eye and imagination of marketing managers and researchers alike (Miller and Dickson, 2001). The prevalence of Internet/Web-enabled data collection is noticeably evident in new product research. It is estimated that new product research applications (including concept testing and conjoint analysis) account for the highest percentage (31%) of revenues among all types of online research (*American Demographics*, 2001). In particular, applications of conjoint analysis—the foremost technique for assessing attribute preferences in product development efforts (Crawford and Di Benedetto, 2003; Wittink and Cattin, 1989; Wittink et al., 1994)—are utilizing Internet/Web-enabled technology with increasing frequency. By one estimate, Internet-based conjoint analysis accounts for 40% to 50% of all conjoint analysis applications (Orme, 2001).

The union of Internet/Web-enabled technology with the technique of conjoint analysis in the product development arena is understandable. For the better part of the past decade, computer-aided interviewing has grown in popularity along with software advances necessary for conducting conjoint analysis studies in a computer-mediated environment (Sawtooth Software, 1999; Salzman and MacElroy, 1999). It was a modest step in an evolutionary sense to progress from traditional paper-and-pencil instruments, to disk-by-mail interviewing, to Internet/Web-enabled conjoint analysis studies.

Research on conjoint analysis applications has demonstrated equivalence of results across traditional offline data collection methods, including in-person interviews, self-administered mail questionnaires, and telephone surveys (Akaah, 1991). Two studies (Melles et al., 2000; Miller et al., 2001) have compared Internet/Web-enabled conjoint analysis with paper-and-pencil administration. These studies suggest similar results across methods of administration, albeit with minor qualifications. A reasonable assumption from these findings, pending contrary evidence, is that results from Internet/Web-enabled conjoint analysis would be comparable with traditional offline data collection methods.

It is noteworthy that the two studies demonstrating equivalence of results across Web and paper-and-pencil methods of administration share a common approach: they simply trans-

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ferred the instrumentation common to offline methods of administration to the "Web." Specifically, both studies used terse verbal descriptions of product attributes and attribute levels. Neither study capitalized on the visual capabilities of Internet/Web-enabled technology in the depiction of attributes and attribute levels. Contemporary conjoint studies are increasingly exploiting the visual capabilities of the Internet, for instance, by using enhanced pictorial descriptions of attributes (e.g., see Dahan and Hauser, 2002).

A diverse body of literature suggests that the visual capabilities of Internet/Web-enabled technology along with user interface improvements may change the conjoint analysis study environment relative to the traditional paper-and-pencil method. For instance, drawing on the human–computer interaction literature, Hoffman and Novak (1996) argue that "vividness" in Internet/Web-enabled environments can magnify user involvement and attention. If this is true, then the information processing literature suggests that higher user involvement in an Internet/Web-enabled conjoint analysis task may lead to more attention given to attribute information along with increased scrutiny of this information (Celsi and Olson, 1988). The product development literature also documents how visual enhancement may play a role in Internet/Web-enabled conjoint analysis and concept testing. In this regard, Vriens et al. (1998) report that verbal descriptions were good for facilitating judgment, while visual (pictorial) representations of attributes enhanced study participant's understanding of design-related attributes. Moreover, visual enhancement of images can be better achieved with Internet/Web-enabled technology than with traditional paper-and-pencil instrumentation (Dahan and Srinivasan, 2000). While it is reasonable to conclude that the visual and user interface capabilities of the Internet alters the conjoint analysis study environment and increases participant attention and involvement, what is not known is whether or not online conjoint analysis yields different results from offline methods of administration.

The purpose of this research is to investigate whether aggregate attribute preferences in a conjoint analysis task differed between online and offline data collection methods. As such, this study differs from previous efforts in that the Internet/Web-enabled conjoint analysis method utilizes the visual enhancement capabilities of Internet/Web-enabled technology. Interestingly, we observed significant and practical differences in aggregate preferences between an Internet/Web-enabled and paper-and-pencil (mail-questionnaire) methods of administration. Furthermore, the Internet/Web-enabled method was judged superior to the paper-and-pencil method on the basis of internal consistency and predictive (face) validity.

The paper is organized as follows. First, we describe the design of a field study used to test whether online and offline data collection methods yield the same aggregate attribute preferences. Next, we present the results from the field study. We conclude with a discussion of the results and directions for future research.

2. Field study design

2.1. Study overview

This project was the result of collaborative effort with a major, well-known manufacturer of branded wireless telephone handsets during its ongoing product development effort. Collaboration between academics and practitioners has been a distinguishing characteristic of advances in conjoint methodology over the past 30 years (Green et al., 2001).

The purpose of the conjoint analysis was to identify promising new functional and physical features that could be incorporated into the next generation of wireless telephone handsets. Such research is ongoing in the wireless phone industry (Seitz, 2003). Fifteen attributes (listed in Table 1) were identified by the company for potentially incorporating into new wireless telephone models. The

Table 1
Mean stated importance ratings for wireless telephone attributes by data collection method (0 = *not at all important*, 10 = *very important*)

Attribute No.	Attribute name	Levels	Mean (S.D.)	
			Web	Mail
1	Phone ring	Yes No	4.25 (3.24)	4.06 (2.87)
2	Speaker phone	Yes No	5.11 (3.50)	4.97 (2.89)
3	Phone design	Bar Folder Flip	7.62 (2.39)	7.01 (2.49)
4	Voice command	Yes No	4.59 (3.19)	5.17 (3.04)
5	Personal information manager	Yes No	3.88 (3.07)	4.08 (2.81)
6	PDA/Palm top	Yes No	3.11 (2.90)	2.95 (2.94)
7	Instant messaging	Yes No	3.92 (3.39)	4.24 (2.73)
8	E-mail access	Yes No	4.62 (3.46)	4.74 (2.78)
9	Internet access	Yes No	3.47 (3.19)	3.88 (2.91)
10	Wireless synchronization	Yes No	2.96 (3.15)	2.87 (2.89)
11	Display size	5 lines 7 lines 12 lines	4.6 (3.27)	4.06 (2.65)
12	Display color	LCD Indiglo 4-color Full color	3.55 (2.92)	3.14 (2.72)
13	Display capability	None Animation Video	2.25 (2.85)	2.58 (2.46)
14	Play games	Yes No	1.59 (2.57)	1.78 (2.54)
15	Play music	Yes No	1.73 (2.40)	2.64 (2.84)

target segment for the product was 25- to 44-year-old wireless telephone owners—the primary user segment (DataQuest, 1999). A Web-based conjoint study and a comparable paper-and-pencil based study were designed to compare the results from the two methods of administration.

The concurrent studies incorporated two commonly used approaches for measuring feature importance: (a) an importance-rating task and (b) a choice conjoint task. In the importance-rating task, study participants were asked to state the importance of each feature when purchasing a wireless telephone. Responses were averaged to calculate a mean importance. These aggregate numbers were labeled "stated importance" because participants directly provided the importance ratings. The mean stated importance was obtained from matched samples using both Web and a mail-based data collection method. The difference between the two means served as a measure of method difference in the importance-rating task.

For the conjoint task, study participants made choice decisions among several wireless telephone profiles each representing different combinations of attribute levels. Aggregate consumer preferences (part-worth utilities) for the different levels of each attribute were estimated using a multinomial logit model specification. The importance of each attribute was obtained as the difference in utilities between the level with the highest utility and the level with the lowest utility (Vavra et al., 1999). These estimates were labeled "derived importance" because importance estimates were derived from a choice task. Aggregate importance estimates were obtained from matched samples using both the Web- and mail-based data collection methods. Method difference in the conjoint task was based on the difference between the two estimates.

2.2. Survey instrument

In both studies, the survey instrument first provided a brief verbal description of the 15 wireless telephone features. Because several attributes (e.g., phone design and display color) had a dominant visual component, it was recognized that a pictorial representation of these attributes would best communicate their characteristics. For consistency in presentation, study participants were provided a pictorial representation of all 15 features, accompanied by a brief written description. Descriptions for a representative sample of attributes are presented in Fig. 1. Fig. 1A presents two attributes (phone design and display color) with a greater visual component—the pictures help understand the characteristics of these attributes. Fig. 1B presents two attributes (personalized ring and speaker phone) with lesser visual component—the pictures act more as visual icons. For each attribute, participants were asked to state how

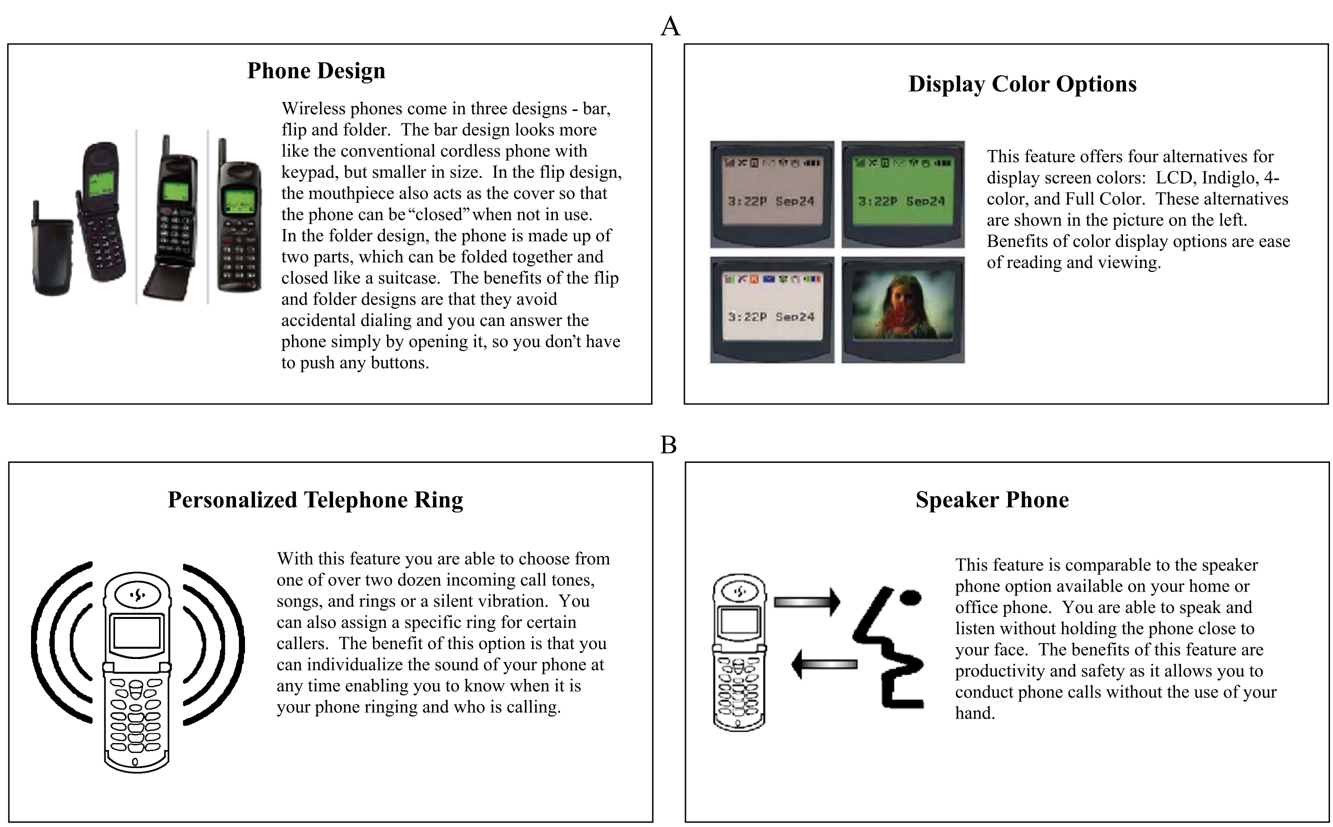

Fig. 1. Visual and verbal descriptions of representative attributes. (A) Visual description-oriented attributes. (B) Verbal description-oriented attributes.

important the feature would be in their purchase decision on a 0–10 interval scale (0 = *not at all important*, 10 = *very important*).

The conjoint choice task was developed using a full-profile fractional factorial design. The 15 attributes were used to form 15 choice sets of three profiles each for a total of 45 profiles. Study participants were asked to choose the profile they preferred most. Information was also collected on five demographic variables (listed in Table 2) that could potentially influence preferences for wireless telephone features.

Every attempt was made to keep the instrument as equivalent as possible across the two data collection methods. Nevertheless, there were some differences endemic to the two methods:

(i) For pictorial descriptions of attributes, photorealistic representations in true colors were presented on the screen in the Web-based study. Color copies of these pictures were presented in the mail-based study.
(ii) The background was in blue and the text was in red print to make the visual presentation aesthetically pleasing and attention getting in the Web-based study. As in a typical mail survey, the survey instrument had a white background with black text.
(iii) When answering the choice questions, the Web study participants could refer back to any particular attribute by clicking on the appropriate feature in the choice set. Mail study participants were required to manually refer back to earlier pages in the instrument for the attribute descriptions, if they wanted more information.

2.3. Field study administration

A professional field research firm administered the survey instrument in both studies. A random sample of 1000 wireless telephone owners in the 25- to 44-year-old age group was obtained from a professional sampling company: 500 were subsequently assigned randomly to participate in the Web study and 500 were randomly assigned to participate in the mail study. Prospective Web-study participants were contacted to solicit their cooperation and directed to a Web site. Prospective mail study participants were contacted and sent the paper-and-pencil instrument.

The same participation incentive ($10, or a chance to participate in a lottery for $100) was offered to potential survey participants in both samples. Complete information on attribute importance, conjoint choice, and sample characteristics were obtained from 172 Web participants and 136 mail participants.

2.4. Obtaining matched samples

In order to focus on differences in aggregate preferences arising from two different data collection methods, a matching approach was used to minimize differences in sample composition. Matching was accomplished by blocking on observed demographic characteristics. For each observation in the mail sample, a Web sample participant who matched on all available demographic characteristics was selected. For example, both participants in a matched pair were 25- to 29-year-old female executives, married with children under 18, with a household income of $75,000–$125,000. Nonmatching participants were excluded from the analysis. Eighty-five matched pairs were obtained using this procedure.

Despite these attempts at minimizing sample differences, there may be some unobserved sample characteristics on which the two groups systematically differ. Such sample differences, if they exist, should affect both the stated importance from the importance-rating task and the derived importance from the conjoint task. Therefore, the stated importance variable acts as the benchmark (in some sense a control group) when assessing a data collection method difference in conjoint analysis. In summary, sample differences between the Web and mail study participants were accounted for by (a) randomly assigning them to the two groups, (b) blocking on key demographic variables, and (c) having a benchmark by measuring stated importance from a rating scale.

The design used in this field study can be characterized as a between-subjects design that compares results from a matched sample of Web respondents and mail respondents. An alternate approach would be to use a within-subjects design where the results are compared from the same group of consumers who provide responses both online and off-line. While the within-subjects design is suitable for a controlled experiment to rule out alternative explanations, this design has potential problems especially in a field study due to

(i) demand effects: Respondents may reproduce from memory (or even from a copy of their first survey) what they stated earlier, in order to be consistent,

Table 2
Demographic characteristics

Variable	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Gender	Male	Female				
Age (years)	25–29	30–34	35–39	40–44		
Income (thousand $)	<35	35–75	75–125	>125		
Marital status	Single with no child <18	Single with child <18	Married with no child <18	Married with child <18		
Occupation	Homemaker	Self-employed	Executive	Skilled technician	Clerical	Other

(ii) history/testing effects: Respondents' views may change in the time frame between the first and second survey, or some learning might take place as a result of the first survey that may change responses to the second survey.

Furthermore, most field studies comparing online and offline survey methods (Harris Interactive Report, 2000; Couper, 2000), use across-group (between-subject) comparisons.

3. Study results

3.1. Examining differences

3.1.1. Difference in attribute importance ratings

The mean importance ratings for the 15 attributes are given in Table 1 for the two data collection methods. We tested the equality of the vector of attribute means. A test of centroid equality failed to reject the null hypothesis that the vector of attribute means is the same across the two populations [$F(15,154)=1.26$, $P>.10$].

The Spearman rank order correlation between stated importance in the Web-based study and the stated importance in the mail-based study obtained from the rating scale was high (.95) and statistically significant. Phone design was the most important attribute in both data collection methods. Speaker phone, E-mail access, and voice command were among the most important attributes. Display capability, ability to play games or music were the least important features in both study settings.

3.1.2. Difference in conjoint analysis

To estimate the attribute preferences or aggregate part-worth utilities, a multinomial logit choice model was employed using SAS (Kuhfeld, 1996). To test if the part-worth utility coefficients obtained from the two data collection methods were significantly different, we applied a procedure suggested by Swait and Louviere (1993). The multinomial logit estimation equation is given by

$$\Pr(i) = \frac{\exp(\mu\boldsymbol{\beta}\boldsymbol{x}_i)}{\sum_j \exp(\mu\boldsymbol{\beta}\boldsymbol{x}_j)} \tag{1}$$

The constant μ is the scale factor for a particular data set. Vector $\boldsymbol{x}$ represents the attribute levels of ith profile and $\boldsymbol{\beta}$ is the vector of logit coefficients representing part-worth utilities. For testing whether the two samples—Web (W) and mail (M)—share the same population parameters, the appropriate null (H_0) and alternate (H_A) hypotheses are

$$H_0 : \boldsymbol{\beta}_W = \boldsymbol{\beta}_M \text{ and } \mu_W = \mu_M;$$

$$H_A : \boldsymbol{\beta}_W \neq \boldsymbol{\beta}_M \text{ and/or } \mu_W \neq \mu_M.$$

To test this joint hypothesis, Swait and Louviere (1993) suggest the following procedure. Without loss of generality, scale factor μ_W can be set to 1. Let the scale factor for the mail sample be some value μ_M. Then concatenate the Web data (X_W) vertically with scaled mail data ($\mu_M X_M$). Impose the condition $H_{\beta 0}$: $\boldsymbol{\beta}_W=\boldsymbol{\beta}_M=\boldsymbol{\beta}$, and estimate $\boldsymbol{\beta}$ and the corresponding log likelihood (L_μ) for different trial values of μ_M. Find the value of μ_M that maximizes the log likelihood. Test $H_{\beta 0}$ by computing the likelihood ratio statistic: $\lambda=-2[L_\mu-(L_W+L_M)]$, where L_W and L_M are the log likelihoods obtained separately for the Web study sample and the mail study sample, respectively. λ is distributed asymptotically as chi-squared with $k+1$ degrees of freedom, where k is the number of restricted parameters.

Swait and Louviere (1993) state that if hypothesis $H_{\beta 0}$ is rejected, then the joint hypothesis H_0 is rejected. In this study, $H_{\beta 0}$ is rejected [$\chi^2_{21}=38.5$, $P<.01$]. Hence, the population parameters corresponding to the Web-based method are different from those of the mail-based method. However, the test does not identify whether the inequality is in the part-worth utilities ($\boldsymbol{\beta}$) or scale factors (μ), or both. Because these two effects are confounded, we cannot directly compare the magnitudes of the part-worth utilities from the Web- and mail-based studies and interpret them as differences in attribute preferences. However, the relative preference or relative importance of attributes across the two studies can be compared, as explained below.

The importance of each attribute is obtained in the typical manner as the difference in utilities between the level with the highest utility and the level with the lowest utility (e.g., see Vavra et al., 1999). Relative importance is calculated as the importance of an attribute divided by the total importance of all 15 attributes. Because the scale factor (μ) is in both the numerator and the denominator of the relative importance formula, it cancels out. Fig. 2 presents the relative importance of attributes in percentage terms for the Web- and mail-based data collection methods. The Spearman rank order correlation of the derived relative importance from the two methods is .60. This correlation is considerably lower than the corresponding correlation of .95 for the stated importance from the rating scale.

Visual inspection of relative importance ratings reveals that while there are some agreements, notable differences exist. To illustrate from a managerial perspective, suppose a wireless telephone handset product manager decides to incorporate the top three most important attributes in a new product design. Data collected via the Web-based method would lead the product manager to recommend inclusion of E-mail access, phone (flip) design, and speaker phone (Fig. 2A). Results from the mail-based method would lead to a different configuration recommendation including voice command, e-mail access, and instant messaging (Fig. 2B). Other noteworthy differences are evident from Fig. 2A and B. The top five attributes in the Web-based study account for about 62% of the total importance; in the mail-based study, the top five attributes account for as much as 75% of the total importance. It can also be seen that features with an important visual component (phone design, display size, display capability, display color) account for nearly 31% of the total

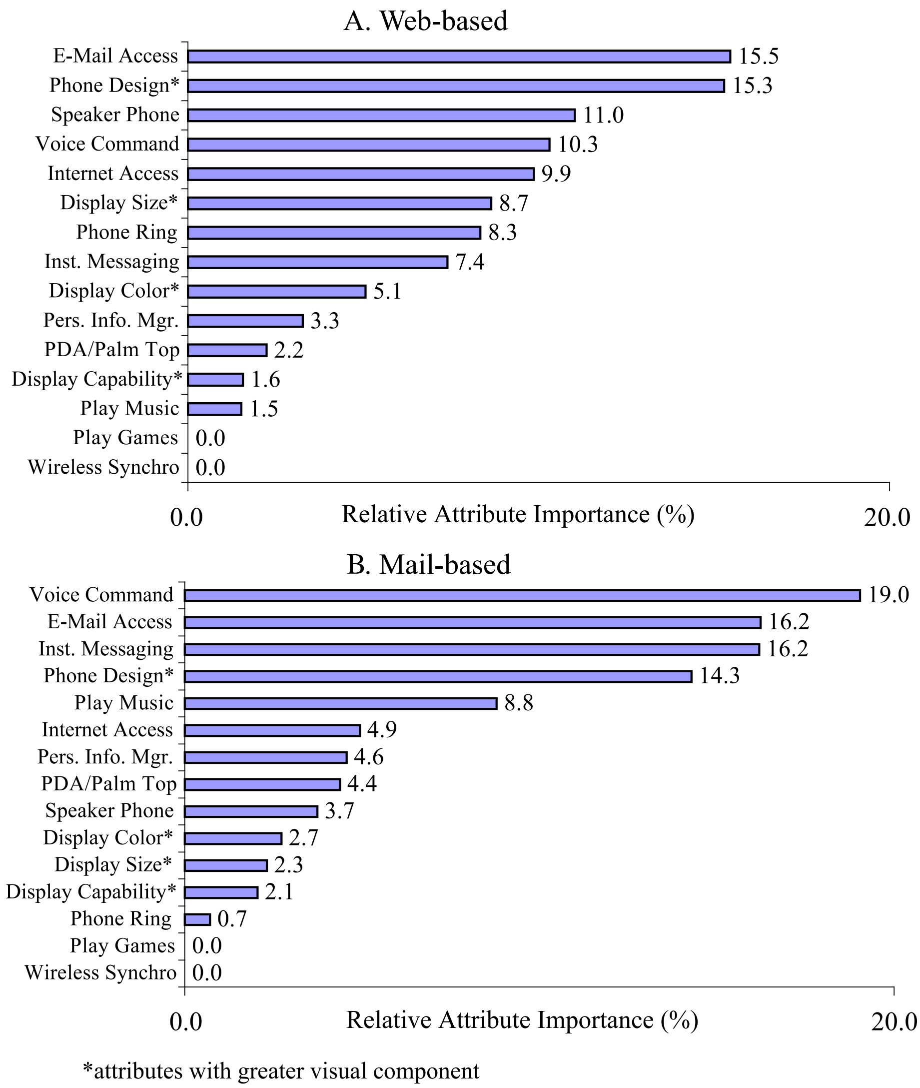

Fig. 2. Relative attribute importance from conjoint analysis by data collection method. (A) Web-based. (B) Mail-based.

importance in the Web-based study; but for only 21% of the total importance in the mail-based study.

3.1.3. Analysis with the full sample

We analyzed matched samples of 85 respondents each in online and paper-and-pencil methods of administration to account for sample differences to the best extent possible. The basic results were the same even when we used a nonmatched (full) sample of 172 online respondents and 136 paper-and-pencil respondents. The Spearman rank order correlation of the derived relative importance from the two methods with full sample is .51; the corresponding correlation for the stated importance from the rating scale is .95. The top five attributes in the Web-based study account for about 62% of the total importance; in the mail-based study, the top five attributes account for as much as 71% of the total importance. Features with a significant visual component (phone design, display size, display capability, display color) account for nearly 38% of the total importance in the Web-based study, compared with 27% of the total importance in the mail-based study. All of these findings are consistent with results from the matched samples reported previously. Detailed results are available from the authors.

3.2. Evaluation of relative superiority

Since different data collection methods yielded different results when using conjoint analysis, a natural follow-up question is which method is superior. The relative superiority of the two methods was evaluated on two criteria: internal consistency and predictive (face) validity.

3.2.1. Internal consistency

For the Web-based conjoint analysis measure of derived importance, the stated importance from the Web-based rating scale represents a comparable internal measure (two different measures of the same construct from the same respondent). The rank correlation between derived importance and the stated importance in the Web-based study was .91. Similarly, for the mail-based conjoint analysis measure of derived importance, the stated importance from the mail-based rating scale represents a comparable internal measure. The rank correlation between the two measures from the mail study was .64. Clearly, measures of attribute preferences in the Web-based study were more internally consistent than those in the mail-based study.

3.2.2. Predictive (face) validity

An ideal approach for evaluating the relative superiority of data collection methods would be to compare the predictions from the conjoint analysis task to actual market data. However, in this study, several of the features being considered were new to the company and/or the market. As is typical for new and technology-based products (Wittink, 2000), there were no comparable wireless telephone profiles in the market and therefore external market data were not available.

Accordingly, predictive validity was evaluated indirectly through an E-mail survey of wireless telephone industry retailing/marketing executives. The executive survey informed respondents that two different survey techniques (A and B) were used to identify the top seven important features of a wireless phone (from a list of 15 selected features) for 25- to 44-year-old wireless telephone users. The top seven attributes were chosen because they accounted for at least 79% of the total importance in both data collection methods. The executives were then presented with the top seven attributes in the order of importance from the Web-based conjoint analysis (Fig. 2A) and mail-based conjoint analysis (Fig. 2B), randomly assigned as Study A or Study B. The executives were unaware of which study was implemented online and which was conducted offline. Each executive was asked the following question.

Based on your knowledge of the market for wireless telephones among 25- to 44-year-old current wireless telephone users, which feature set more closely corresponds with actual market preference. Please check one.

___Study A ___Study B

A convenience sample of 60 industry marketing/retailing executives were contacted and 32 replied. Twenty-six of the 32 (81.3%) executives stated that study preferences corresponding to the Web-based conjoint analysis represented actual product preferences of 25- to 44-year-old wireless telephone users more closely than preferences from the mail-based conjoint analysis study.

4. Discussion and conclusions

The union of Internet/Web-enabled technology with the technique of conjoint analysis is growing in popularity, and particularly in the new product development arena. The findings reported in this investigation indicate that researchers can expect to observe different results depending on whether they use a Web- or mail-based data collection method for implementing conjoint analysis, even if they account for sample (demographic) differences. Our findings also indicate that a Web-based method may be actually superior to a mail-based method in estimating attribute preferences using conjoint analysis.

4.1. Explaining differences

To the extent that sample confounds have been minimized, alternative explanations for the observed differences that are rooted in the technology and task environment can be explored. Our analysis of the relative importance ratings of attributes indicated that Web-based study participants tended to focus on more attributes when making choice decisions in the conjoint analysis task than did mail-based study participants. This tendency suggests greater participant attention and involvement in the conjoint analysis task occurring in a computer-mediated environment than a paper-and-pencil setting, based on the consumer involvement and human–computer interaction literature (Hoffman and Novak, 1996). Greater involvement may arise due to the novelty or high-tech nature of the medium, or due to greater familiarity (with the Web) of those participants who elected to participate in the Web survey. Greater attention and involvement may also explain the higher internal consistency between the derived importance and stated importance measures in the Web-based study than in the mail-based study. Interestingly, the tendency to focus on fewer attributes, while a potential mediator of differences in a conjoint task, is not an issue in the importance-rating task. (In the importance-rating task, the respondent is asked to state how important each attribute is when purchasing a wireless telephone, at the end of each attribute description.) This tendency may explain why we do not find a significant difference across data collection methods in the mean importance obtained from a rating scale.

Further inspection of the attribute relative importance ratings also highlight the role that visual enhancement of pictorial objects can play in a Web-based versus a paper-and-pencil-based conjoint analysis task. Prior research (Dahan and Srinivasan, 2000; Vriens et al., 1998) has shown that for attributes with a significant visual component, pictorial images are superior to written descriptions and visual enhancement of images can be better achieved with online surveys than paper-and-pencil studies. Our analysis of relative importance ratings indicated that wireless telephone features with a conspicuous visual component (phone design and display size, capability, and color) were more prominent in the Web-based conjoint analysis study than in the mail-based study. This finding is consistent with the view that “vividness” in a computer-mediated environment magnifies attention and involvement (Hoffman and Novak, 1996), which, in turn, could amplify the relative importance of attributes that are best portrayed visually rather than through written descriptions. These explanations seem reasonable for the product category and attributes examined in this inquiry, or other investigations of technology-based products and features with a significant visual component.

4.2. Research implications

The results of this investigation offer useful perspectives to consider when choosing between Web-based versus mail-based full-profile conjoint analysis for new product research. Most notably, our study indicates that the two data collection methods can produce substantively different results. Relatedly, this investigation also cautions against merging responses obtained from the two data collection methods. Researchers should also make special note of the visual enhancements made possible by Internet/Web-enabled technology and the role it can play in a computer-mediated environment for new product research. Through use of matched samples, our investigation illustrated that preferences are higher for attributes with a visual component when data are collected in a computer-mediated environment than when data are collected in a paper-and-pencil environment. As also pointed out by Dahan and Srinivasan (2000), such visual enhancements may reveal preferences that are closer to actual market conditions.

4.3. Limitations and future research

Our analysis suggesting that Internet/Web-enabled full-profile conjoint analysis may be superior to a mail-based method should be welcome news to those interested in using interactive data collection in new product research. The finding also supports the current movement toward online data collection. Nevertheless, we acknowledge that this investigation is based on a between-subjects research design comparing Web- and mail-based data collection methods in a single context for one product category using a single (national) sample.

In Section 2.4, we explained our rationale for using a between-subjects design in our specific field study context and outlined the steps taken to minimize sample differences. Despite these efforts, the observed differences in the results could be attributable to sample characteristics unaccounted for in our research. However, if the differences in results arose from sample differences, such differences must be observed in both the importance ratings and in the conjoint task. The fact that the differences were nonsignificant in the ratings task but significant in the conjoint task suggests that the differences can be at least partly attributed to the difference in data collection method for the conjoint task. Nevertheless, future research can test for differences arising from data collection methods using a within-subject design.

Future research may also investigate other product categories and other types of conjoint tasks under different market conditions. In a recent comprehensive work, Chakraborty et al. (2002) compared the performance of ratings and choice conjoint analysis under different simulated market conditions. They suggest that market conditions such as consumer heterogeneity and product similarity might dictate which conjoint method is better in predicting market shares. In a similar vein, online and offline data collection methods can be compared for different product categories and different markets to test the generalizability of the results reported here.

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References

Akaah IP. Predictive performance of self-explicated, traditional conjoint, and hybrid conjoint model under alternative data collection modes. J Acad Mark Sci 1991;19(Fall):309–14.

Where the money is. American Demographics 2001 (June);39.

Celsi RL, Olson JC. The role of involvement in attention and comprehension processes. J Consum Res 1988;12(December):210–24.

Chakraborty G, Ball D, Gaeth GJ, Jun S. The ability of ratings and choice conjoint to predict market shares: a Monte Carlo simulation. J Bus Res 2002;55:237–49.

Crawford M, Di Benedetto A. New products management. 7th ed. Burr Ridge (IL): McGraw-Hill/Irwin; 2003.

Couper MP. Web surveys: a review of issues and approaches. Public Opin Q 2000;64(Winter):464–94.

Dahan E, Hauser JR. The virtual consumer. J Prod Innov Manag 2002;19(September):332–53.

Dahan E, Srinivasan V. The predictive power of Internet-based product concept testing using visual depiction and animation. J Prod Innov Manag 2000;17(March):99–109.

DataQuest. North American wireless cellphone market; 1999 August 16.

Green P, Krieger A, Wind Y. Thirty years of conjoint analysis: reflections and prospects. Interfaces 2001;31(3):556–73.

Harris Interactive Report. An interview with our methodology expert. Rochester (NY): Harris Interactive; 2000. http://www.harrisinteractive.com/tech/HI_Methodology_Overview.pdf.

Hoffman DL, Novak TP. Marketing in hypermedia computer-mediated environments: a conceptual foundation. J Mark 1996;60(July):50–68.

Kuhfeld WF. Multinomial discrete choice modeling. Cary (NC): SAS Institute; 1996.

Melles T, Lauman R, Holling H. Validity and reliability of online conjoint analysis. Proceedings of the Sawtooth Software Conference. Sequim (WA): Sawtooth Software; 2000. p. 31–40.

Miller TW, Dickson PR. On-line market research. Int J Electron Commer 2001;5(Spring):39–67.

Miller TW, Raka D, Sumitomo T, Hollman RS. Reliability and comparability of choice-based measures: online and paper-and-pencil methods of administration. Proceedings of the Sawtooth Software Conference. Sequim (WA): Sawtooth Software; 2001. p. 46–51.

Orme B. Sawtooth Software. Personal correspondence; 2001.

Salzman A, MacElroy WH. Disk-based mail surveys: a longitudinal study of practices and results. Proceedings of the Sawtooth Software Conference. Sequim (WA): Sawtooth Software; 1999. p. 43–53.

Sawtooth Software. CBC for windows. Sequim (WA): Sawtooth Software; 1999.

Seitz P. Cell phone, PDA makers work to find ideal mix of features. Investor's Business Daily 2003 (January 22);1.

Swait J, Louviere J. The role of the scale parameter in the estimation and comparison of multinomial logit models. J Mark Res 1993;30(August):305–14.

Vavra TG, Green PE, Krieger AM. Evaluating EZPass: using conjoint analysis to assess consumer response to a new tollway technology. Mark Res 1999;11(Summer):5–16.

Vriens M, Looschilder GH, Rosbergen E, Wittink D. Verbal vs. realistic pictorial representations for including design-attributes in conjoint analysis. J Prod Innov Manag 1998;15(September):455–67.

Wittink DR. Predictive validation of conjoint analysis. Proceedings of the Sawtooth Software Conference. Sequim (WA): Sawtooth Software; 2000. p. 221–38.

Wittink DR, Cattin P. Commercial use of conjoint analysis: an update. J Mark 1989 (July);53:91–6.

Wittink DR, Vriens M, Burhenne W. Commercial use of conjoint analysis in Europe: results and critical reflections. Int J Res Mark 1994;11:41–52.