Using Web2.0 Social Network Technology for Sampling Framework Identification and Respondent Recruitment: Experiences with a Small-Scale Experiment

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Abstract.
In this paper, we report the results of a small–scale experiment to explore the potential of using social network technology for respondent recruitment. Of particular interest are the following questions (i) can social media be used for the identification of sampling frames, (ii) what response rates can be achieved by using social media, and (iii) is there evidence of any behavioral sampling bias by using social network technology for respondent recruitment? The results are based on a study of leisure/vacation behavior of the youth. The main findings of this small scale study indicate that (i) the use of social media results in low response rates, and (ii) that the behavior of respondents recruited via social media does not differ significantly from the behavior of respondents recruited by traditional means. These mixed findings suggest that social media may be a welcome addition in mixed mode survey designs.

1. INTRODUCTION

Empirical evidence suggests that response rates are rapidly dropping across the world (*1, 2*). While consultants still report response rates between 50 and 60%, academics report significantly lower numbers of between 10-15% (*3-7*). It goes beyond the scope of this paper to contemplate the reasons for these significant differences, but it seems that consultants put in substantially more effort to achieve these positive results.

Because respondent burden for travel surveys has increased as relatively simple and straightforward questions have been replaced with more demanding activity-travel diaries, for this reason alone, it is not unlikely that response rates will decline further in the near future. Transportation researchers are however facing several additional challenges in collecting travel data. In general, the surveying approach has shifted from face-to-face interviews and mail questionnaires to phone and internet-based interviews. Diaries, however, are highly demanding and are therefore difficult to administer by phone without jeopardizing the reliability and validity of the data. Face-to-face interviews allow, at least in principle, relatively easy identification of a random sampling frame. Phones may be more problematic in this regard, while it is well-known that Internet-based surveys typically result in biased samples (*6*; *8-10*).

Keeping these considerations in mind, transportation researchers need to be very creative in collecting valid and reliable data of activity-travel patterns. It seems that mixed data collection methods, involving different means of administration, are unavoidable. Web2.0 technology may be one of the new technologies, offering potential. Especially social media, such as Facebook, Twitter, Hyves and several others have rapidly gained attention. Their potential for marketing and qualitative data analysis has not gone unnoticed and many marketing departments of major businesses have jumped on the bandwagon and trace social network sites and communities (*11-16*).

To the best of our knowledge, experience with the application of such technology in the transportation research community is scarce. While the technology has already proven its usefulness for marketing purposes, the question is whether it could also be used as a sampling frame in the context of mixed data collection. To explore the potential of the technology, as part of a data collection on leisure travel behavior of the youth segment, we used different sampling frames, including Web-based social network technology. This paper reports the main findings of this study.

The paper is organized as follows. First, we will describe the data collection effort. This is followed by a description of the main results and experiences. We conclude the paper with a summary of major conclusions and a discussion of problems remaining for future research.

2. WEB2.0 TECHNOLOGY

The term Web 2.0 technology is loosely coined to express the notion that the Internet facilitates interactive information sharing and collaboration. Examples include web-based communities, video-sharing sites, wikis, blogs and social-networking sites. Thus, Web 2.0 technology allows between-users interaction or changing website content in contrast to non-interactive websites where users are limited to the passive viewing of information that is provided to them. In this study, we were primarily interested in the potential of social network sites for respondent recruitment. Several social networks, some international, other national, exist and they vary

somewhat in flavor. The best known social networking sites are Facebook, LinkedIn, and Twitter. A major Dutch site is Hyves.

LinkedIn is a professionally-oriented social networking site, mainly used for professional networking. In contrast, Facebook is mainly used for non-professional networking. It is a social networking portal and has various features including email, instant messaging, image and video sharing. Facebook provides a single alternative, with one login, to Yahoo Messenger, Hotmail, Flickr, YouTube, MySpace, etc. Twitter is a social networking and microblogging service that enables its users to send and read messages. These so-called *tweets* are text-based and can contain up to 140 characters displayed on the author's profile page and delivered to the author's subscribers. Thus, Twitter supports a sender-followers system, in which senders can restrict delivery to his/her social network, or allow open access. Important in the context of the present paper is that, since late 2009, users can follow lists of authors instead of individual authors.

Several features of this technology make it potentially relevant for the identification of sampling frames and/or respondent recruitment. For example, Facebook allows starting groups on a particular topic, including groups focused on local areas. If these groups are of interest to a particular study, either in terms of topic or in terms of location, they make up a potential sampling frame (assuming that being a member of a social network bears no systematic relationship with the topic under investigation). Similarly in LinkedIn and Twitter, the "communities" related to certain topics can be used to identify sampling frames of interest. Unfortunately, for most sites, the only information available about the composition of the community is related to their size. Information about age, gender, occupation etc. in terms of a summarized table is typically not available. To access people belonging to a determined community, one should make them part of one's own profile, which means this person has to accept this connection before communication is possible.

3. THE EXPERIMENT

In the context of a larger scale project on agenda formation and execution from a lifestyle perspective (*17*), we needed to collect data on the history of leisure trips and future plans of different lifecycle groups. Leisure trips in this context include long holidays (absence from home for leisure or recreation purposes, with more than 4 nights away from home), short holidays (absence from home for leisure or recreation purposes, between 1 and 3 nights away from home) and day trips (all activities undertaken for leisure purposes, at least 2 hours out of home and without overnight) (*18*). In addition to such temporal information, for every specific lifecycle group additional data is collected. The data used in this paper concern the influence of discount airlines on vacation decisions of the youth segment.

The survey includes questions related to the history of long holidays of young people, conducted over the last 10 years. More specifically, respondents were asked to report the destination, year of the trip, season, travel mode, travel party, accommodation and duration. Except for destination, which should be provided by typing the name in a text area, respondents were presented with drop-down lists with pre-defined categories of each facet. The default value set in the drop-down list for all variables was "I don't remember", and these values were treated as missing values in the current data analysis.

To explore the potential of Web2.0 social network technology, different ideas to identify sampling frames were combined. In particular, the following procedures were followed:

- Using a database of email addresses of students of our university
- Using a database of schools other than the university by adding the link to the survey in the school/university's monthly/weekly newsletters
- Distribute invitation cards to youngster in places where many youngsters meet (city centre, train and bus station)
- Invite participation through social networks such as Hyves, Facebook, Linked-in and Twitter.

An incentive (raffle of 5 travel-voucher worth of 100 Euros) was offered to the respondents who completed the survey. In order to invite people from the social networks to participate in the survey, the first step was the creation of a profile in each of the four selected websites (Facebook, LinkedIn, Hyves and Twitter). Each profile was created with some personal information about the principal researcher, details about the research project and a link to the online survey. The next step of the recruitment process was searching respondents through communities related to travel, holiday, summer vacations, etc. or simply communities related to young people, not directly related to travel, followed by the addition of these communities to the created profile. The link to the survey was, then, posted in the forums of the selected communities as it could not be sent directly to members because most of the social media websites offer protection against spam. Another idea was to try to invite people to join the network of the created profile, but it turned out that people were very reluctant to add unknown people (in this case, the profile of the principal researcher) to their personal network. It means that the 34 respondents who accessed the link to the survey received it from a link posted in the forums of communities of which they were members.

4. SAMPLES

A total of 212 respondents completed the survey, and from this total, 34 received the link to the survey through social networks communities. Table 1 shows the response rates for the different social media. Obviously, the response rates are very low (Facebook 0.035%, LinkedIn 0.368%, Hyves 0.006% and Twitter 0%), recognizing that the size of the sampling frames for some of these media is actually very high. The comparison between the 178 respondents recruited in conventional ways and the 34 respondents recruited by social media shows that response rates are also smaller when the link to the survey was posted in newsletters (0.55%) than for direct email (17.44%) and invitation cards (13.5%). It suggests that many newsletters are not carefully read.

Some other interesting comparisons can be made regarding the composition of the two ways of recruitment. In the sub-sample of respondents recruited via social media, women were over-represented (65%) against 47% in the sub-sample recruited in conventional ways. Regarding their age, in both cases most of the respondents are between 19 and 24 years-old. The respondents are mostly high-educated, have an income level less than 1000 Euros, don't possess a car, but have a driver's license and are Dutch. Note that some of these characteristics can be attributed to the fact that the study concerned the youth travel segment.

Household composition shows that most respondents recruited in conventional ways live alone or with 1 more person, whereas respondents recruited via social networks live mostly in a household of 4 people. Social media' respondents have 1 or 2 cars in the household while most

respondents in the conventional sub-sample have none or 1 car in the household. Another difference between the two groups is that the conventional sub-sample spends more time working and studying comparing to the social media sample. These findings suggest that people recruited in conventional ways are mostly university and college students, it is likely that they live apart from their parents, whereas the majority of people recruited via social networks appears to still live in their parents' home. This should also explain the difference in household composition and car availability.

TABLE 1 Sample characteristics – comparison between sample from social networks and others

Variable	Levels	N=34 (Social Networks)	N=178 (Conventional)
Number of respondents and Response rates in ( )	Facebook	9 (0.035%)	-
	Linkedin	12 (0.368%)	-
	Hyves	14 (0.006%)	-
	Twitter	0	-
	E-mail	-	94 (17.44%)
	Invitation cards	-	27 (13.50%)
	Post in newsletters		55 (0.65%)
Gender	Female	65%	47%
	Male	35%	53%
Age	14 to 18	29%	7%
	19 to 24	44%	53%
	25 to 30	18%	35%
	31 more	9%	5%
Education level	Low	3%	-
	Medium	32%	3%
	High	65%	97%
Income level	<1000	73%	76%
	>1001, < 2000	27%	20%
	> 2001		4%
Car owner	No	70%	81%
	Yes	30%	19%
Driver's license	No	26%	30%
	Yes	74%	70%
Nationality	Dutch	80%	58%
	European	20%	21%
	South American	-	3%
	Asian	-	11%
	Other	-	7%
Number of people in the household	1	21%	26%
	2	26%	27%
	3	21%	17%
	4	29%	15%
	more	3%	15%
Number of cars in the household	0	15%	52%
	1	41%	25%
	2	35%	15%
	3	9%	5%
	more	-	3%
Hours spending working and/or studying per week	0 to 10	3%	3%
	11 to 25	-	4%
	26 to 40	53%	40%
	41 more	44%	53%

5. BEHAVIORAL BIAS

Response rates and respondent socio-demographic similarity are only proxy variables for measuring the validity of the data. Increasing response rates reduce the standard error and will therefore, ceteris paribus, increase the significance of estimated statistics. However, the vast majority of studies in transportation research is not primarily interested in significance and confidence levels. Studies wish to assess the impact of independent variables on the dependent variable. If the sample is biased, increasing response rates cannot compensate for such bias.

It is more relevant to compare the sub-samples directly in terms of their travel behavior characteristics. Again, this analysis does not allow one to draw conclusions with respect to the validity of the data, but it does allow conclusions concerning the issue whether the two sub-samples exhibit behavioural differences, which one would like to avoid. In this study, rather than performing direct statistical tests, we applied a CHAID analysis. If the variable "sampling frame" would appear high in the decision tree, it would indicate strong differentiation between the sub-sample obtained from social media and the sub-sample obtained from other recruitment methods in terms of travel. On the other hand, if "sampling frame" would appear low in the tree or not at all, apparently variability in travel behavior cannot be accounted for by the kind of sampling frame that was used after controlling for the other independent variables.

To examine whether destination choice of the two sub-samples is homogeneous after controlling for trip and socio-demographics variables, CHAID (Chi-squared automatic interaction detection) was used. The CHAID models are presented in a tree-form, where the final nodes represent the homogenous groups in terms of the behavior of interest, providing optimal splits by maximizing the significance of the Chi-squared test. When there are significant values for this test, then a Bonferroni adjusted *p*- value is computed for the respective predictor (*19*).

Table 2 shows the dependent and independent variables used in this analysis. The dependent variable is the destination choice for long holidays of youngsters using data over the past 10 years. Two types of categorizations were examined: destination by continent (Analysis A) and destination by type (Analysis B). The independent variables related to the characteristics of the trips were travel mode, travel party, accommodation type, duration of the trip and season. The socio-demographic independent variables were age, income, gender, nationality, education, number of people in the household, hours spend at work and/or school, possession of driver's license, number of cars in the household, possession of own car, and whether the respondent was recruited through social networks communities or not. It is important to state that the database is organized by trips and not by respondents. It implies that the database of 212 respondents consists of 2,035 trips, which served as the dependent variable for the analysis. In average there are 9.55 trips per respondent.

TABLE 2 Variables used in CHAID analysis

	Variable	Category	Description
Dependent variable: Analysis A	Destination (Continent)	AM	Americas
		AF	Africa
		AS	Asia
		E	Europe
		O	Oceania
		D	Domestic (inside The Netherlands)
Dependent variable: Analysis B	Destination (Type)	B	Beach
		C	Culture
		BC	Beach and Culture
		D	Domestic (inside The Netherlands)
		E	Entertainment
		N	Nature
		S	Sport
Independent variables (in both analysis)	Travel mode	1	Regular airlines
		2	Discount airlines
		3	Train
		4	Bus
		5	Car
		6	Other
	Travel party	1	Alone
		2	With partner
		3	With family
		4	With friend (s)
		5	Other
	Accommodation	1	Hotel
		2	Hostel
		3	Camping
		4	Rented apartment
		5	At friend's/ relative's
		6	Other
	Duration of the trip	1	More 4 nights less 1 week
		2	Between 1 and 2 weeks
		3	Between 2 and 3 weeks
		4	Between 3 and 4 weeks
		5	More than 4 weeks
	Season	1	Autumn
		2	Winter
		3	Spring
		4	Summer
	Age	Continuous	From 16 to 36 year-old
	Income	Continuous	From 0 to 4.400 Euros
	Gender	1	Female
		2	Male
	Nationality	1	Dutch
		2	European
		3	South American
		4	Asian
	Education	1	Low
		2	Medium
		3	High
	Number of people in the household	Continuous	From 1 to 8 people

	Hours spend at work and/or school per week	Continuous	From 0 to 70 hours
	Possession of driver's license	1 2	Yes No
	Number of cars in the household	Continuous	From 0 to 6 cars
	Possession of own car	1 2	Yes No
	Respondent recruited via Social Network	1 2	Yes No

The results of the first analysis (destination per continent group) are shown in Figure 1. For each shaded box, the name of the predictor which divides the trips into mutually exclusive groups is reported, together with the Chi-square value, degrees of freedom and Bonferroni adjusted *p* value. The first split of the tree shows that the predictor "travel mode" was the most important in the CHAID model, splitting the trips into three distinctive segments: train, car and other (Node 1), regular airlines (Node 2) and discount airlines and bus (Node 3). This result is not surprising as for trips to other continents it is likely that the mode "regular airlines" is the most used. That is the reason why in the Node 2 the probabilities are more balanced than in Node 1 and 3.

For trips that are made by train, car or other, the next most important predictor was "nationality", with Node 5 being related to the Dutch nationality and Node 4 to all other nationalities. This may be caused because the majority of the respondents are Dutch people. Still analysing this side of the diagram, for the Dutch people who travel by train, car or other, "accommodation" seems to have a significant effect on vacation-destination. Trips were split into three groups of accommodation: at friend's or relative's house, hostel, hotel (Node 10), camping and other (Node 11) and rented apartment (Node 12).

For the part of the diagram that splits regular airlines, "duration of the trip" was the most important predictor, with a stratification of two categories: duration of 2 weeks or less (Node 6) and more than 2 weeks (Node 7). For the trips with duration smaller than 2 weeks, there is an effect of "accommodation", with hotel (Node 14) in a split separately from the other categories (Node 13).

The right hand side of the diagram indicates that trips made by discount airlines or bus were broken into two segments by age of the respondents. One segment is younger than 24 years-old and those older than 24 years-old represent another segment.

Thus, this discussion of the decision tree shows that sampling frame (social media or other) does not appear at all in this tree. It means that there is no significant difference in the choice of destination (according to continent) and even of the underlying determinants between respondents recruited through social media and those recruited in conventional ways.

To further examine this lack of behavioural bias, destinations were also classified in terms of *type* of destination. The results of this second analysis are shown in Figure 2. It indicates, similar for the first analysis, that "travel mode" was the most important predictor of choice of destination type, splitting the tree into four segments: train, car, other (Node 1), regular airlines (Node 2), bus (Node 3) and discount airlines (Node 4).

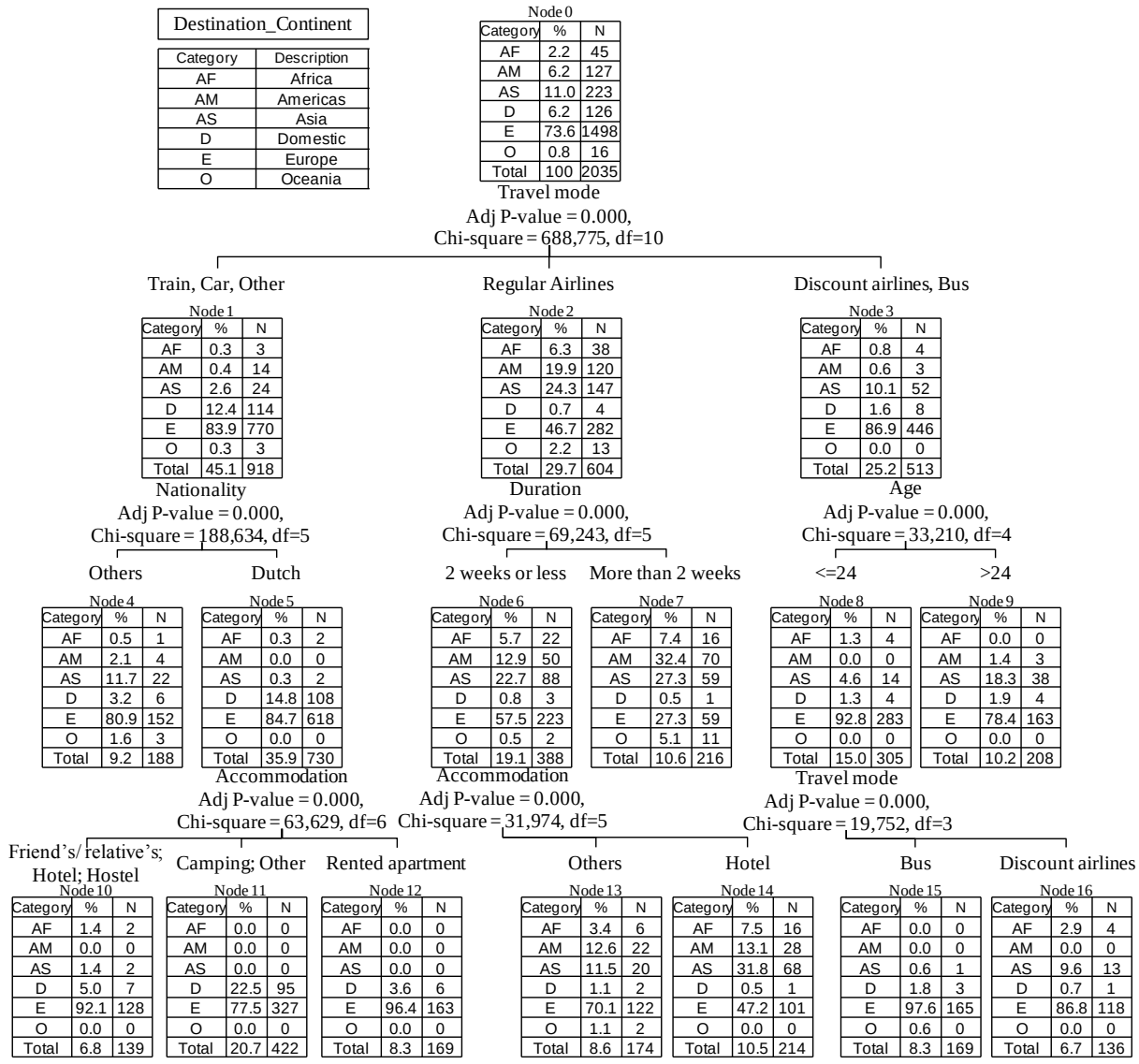

FIGURE 1 Results of CHAID for Analysis A

The left part of the diagram, for the trips made by train, car or other, "season" was the most important predictor, with a difference between "winter" (Node 6) and "others" (Node 5). This result is expected because during the winter the number of trips is smaller compared to the other seasons. The trips made in summer, spring or autumn were split into two groups of accommodations: "at friend's or relative's house, hostel, hotel, rented apartment" (Node 11) and "camping or other" (Node 12), showing that camping is a particular type of accommodation for young people during this season.

Going back to Node 2, for the trips made by regular airlines, the most important predictor of the analysed behaviour was "accommodation". Node 7 includes "at friend's or relative's house, hostel, camping, other" and Node 8, "hotel or rented apartment". This split verifies what is expected as these two categories are quite different in terms of price and type. Node 8 was further

split into Nodes 13, 14 and 15, showing a relationship between choice for "hotel or rented apartment" in terms of age, with three groups (< 21, 22 or 23, and >24 years-old).

There are significant effects of "season" for people travelling by bus (Node 3). Summer trips (Node 9) are in a different category from the other seasons (Node 10), telling that trips by bus are most likely to happen during summer. And finally, for people travelling by discount airlines (Node 4), it seems that the model could not capture significant effects of other variables to explain the choice of destinations by type.

The results of this analysis of destination for long holidays categorized per type of destination, as for the categorization by continent, thus also shows that the variable representing the sampling frame (sample recruited by social media or otherwise) does not appear in the tree. This means that there are no substantial differences in the choice of destination between respondents recruited through social media and those recruited by e-mail, invitation cards or newsletters after accounting for trip and socio-demographic characteristics.

7. CONCLUSIONS AND DISCUSSION

The number of people using modern social network media has rapidly increased lately and is likely to further increase in the near future. As social network sites provide information about the number of people participating in particular communities, these sites and communities are potential sampling frames which may be helpful in light of the increasing difficulty of generating large samples using a single mode data collection. To explore this potential of new social network technology, a small-scale study was conducted in the context of holiday travel behavior.

Results show that, at least in the present context, response rates obtained from social media are very low. One of the reasons for the low response rates may be that the match between general survey topic and the selected communities is not very good. We can imagine that response rates may be higher if respondents are invited to participate in a data collection effort on a topic that is of their immediate interest. If sample composition is not a real issue, respondents may be invited to forward text to their friends, enabling snowballing.

A comparison of the socio-demographics of the two sub-samples indicated some differences. It is difficult to say however that these are structural differences between users of social media and the population at large. Some differences could be interpreted in terms of the specific sampling procedures used. The observed gender differences are interesting however. If indeed women are more inclined to respond via social media (perhaps because they are relatively over-represented) this could compensate for the typically lower response rates of women in Internet-based questionnaires. Future research should further examine this issue.

Most importantly, however, is the finding that at least in this study we did not find any evidence of behavioral bias. The dependent variable of interest (destination choice) did not show any relationship with sampling framework.

Thus, based on this first and small scale study, it seems that social network technology may not be the panacea for large samples and/or high response rates. However, this technology may play a role in mixed data collection efforts. The most important advantages are (i) communities are easily identified, (ii) they are interesting for qualitative data collection (e.g. by using web crawlers), (iii) costs of data collection is very cheap. Moreover, if the results of the

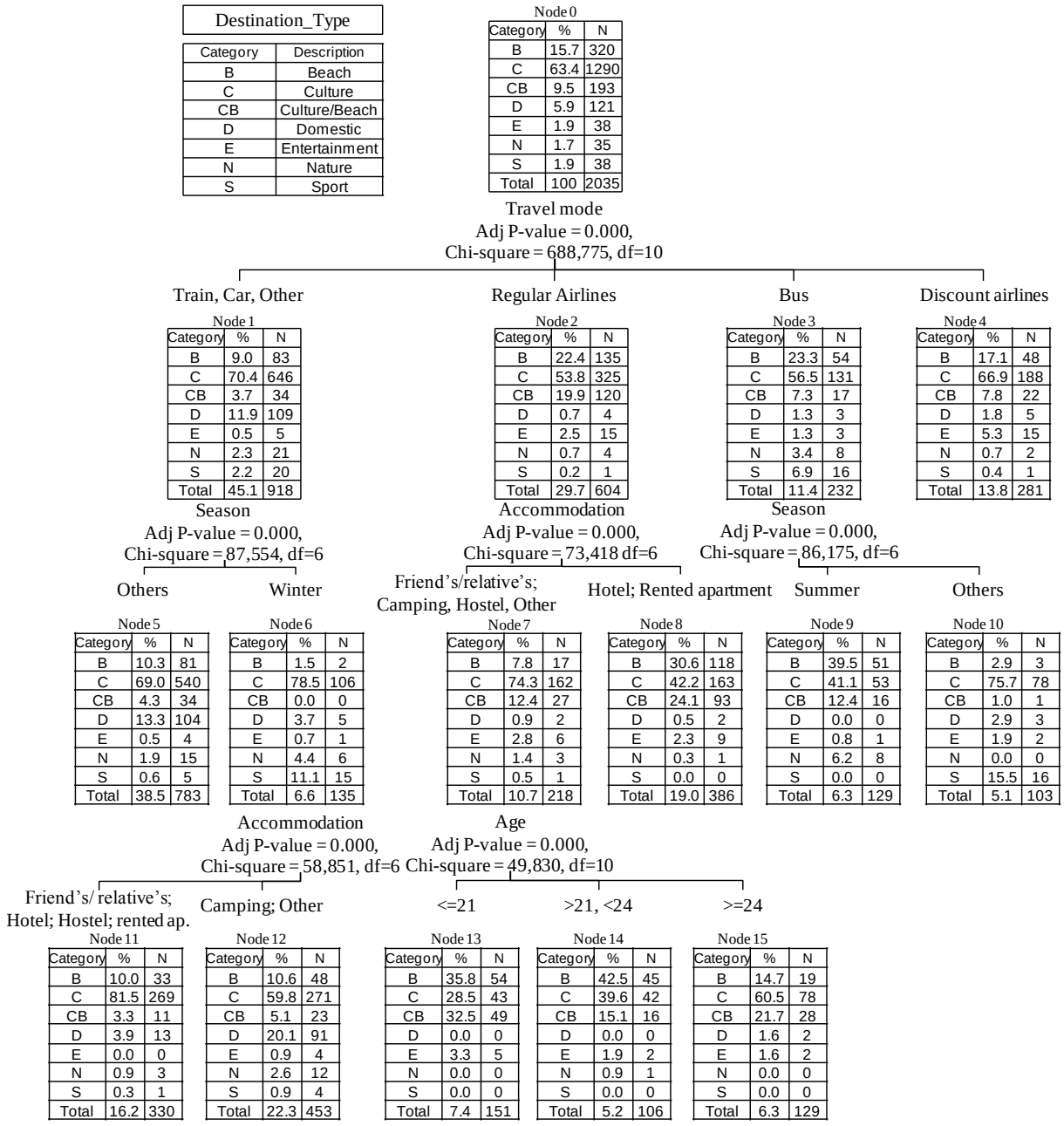

FIGURE 2 Results of CHAID for Analysis B

present study can be generalized, there is no reason to assume that the use of social network technology will introduce behavioral bias. In the end, this lack of behavioral is the most important issue as response rates and socio-demographic representativeness may only tell part of the story if not the wrong story. In any case, it seems that a further exploration of the potential of using social network technology for sampling and respondent recruitment is warranted.

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