

A Survey of the U.S. Public's Preferences for Weather and Road Condition Information

DTFH61-10-P-00112

21-74-10022

1. Introduction

In 2008, the American Meteorological Society (AMS) Board on Enterprise Planning (BEP) established the Committee on Mobile Observations to discuss the application and utilization of mobile weather and road condition data in the context of supporting the weather and transportation communities and how these data could be used to improve safety and mobility across the nation's surface transportation system. The goal of the committee is to articulate a clear vision for mobile data that captures the immense opportunities for these data to improve road weather services and transportation safety.

The Committee on Mobile Observations is engaged in numerous activities to accomplish its goal, and one of its most significant efforts is to conduct a nationwide survey of the traveling public to obtain better information on their preferences for and interests in obtaining weather and road condition information, their willingness to share vehicle data, and their willingness to pay for enhanced services.

2. Science Background

In a perfect world, we would expect that providing better road and weather warning information would lead to increased protective action on the part of the traveling public. However, there is a rich social science literature indicating that people do not respond to warnings and weather information in a linear manner (e.g., [Sorenson 2000](#)). Information systems

comprise both scientific technologies and the people who use them. Importantly, people bring significant perceptual and behavioral histories to the decision-making table.

A whole suite of information — including people's sources, perceptions, and experiences relating to weather and road conditions — needs to be understood and carefully addressed to maximize the possible benefits of scientific advances and technologies. However, there is limited information about people's knowledge and actions regarding weather in general, and even less is known about people's preferences for in-vehicle weather and road condition information, or their willingness to share data measured from their vehicle.

Using an internet survey, this project therefore examines people's weather information-gathering tendencies and preferences, with a focus on road weather conditions. In addition, we include questions on people's comfort level with sharing vehicle data and examine how much people are willing to pay for new types of road and atmospheric weather data.

3. Data Collection

We conducted an Internet survey of US residents during October and November 2010. Prior to sending out the survey, we pre-tested all questions with several verbal protocol analyses to ensure that questions were being interpreted as we planned; additionally, some of the questions used here were asked on other surveys that also used more extensive pre-testing (e.g., [Hayden et al. 2007](#); [Lazo et al. 2008](#)). The complete set of questions is available from the authors.

Working through Survey Sampling International (<http://www.surveysampling.com/>), we obtained 1627 responses. Internet sampling is an attractive option for this type of exploratory study, because it can facilitate gathering data quickly and it allows for better control over respondents' access to the questions (i.e., they cannot jump ahead or go back and change their answers based on information in a subsequent question).

Estimates of Internet access vary widely, but based on the most recent Pew Internet Report ([Smith 2010](#)), about 66 percent of U.S. households (n ~ 62 million) have Internet access at home. As such, using the Internet to conduct the survey inevitably excludes some populations from responding, so it is important to note that the results are not representative of the entire population of the United States. Moreover, future research may warrant using other research

methods that can better access hard-to-reach populations. In comparison with U.S. Census information, the response pool for this survey contained a higher portion of females, was better educated, and was slightly wealthier.

4. Results

This section outlines the main survey results, highlighting information-gathering tendencies, preferences for in-vehicle information, and concerns related to the sharing of vehicle data.

4.1. Information-gathering tendencies

Adverse weather conditions remain a considerable hazard to the US motoring public, leading to over 7,000 fatalities and more than 670,000 injuries in a given year (FHWA, 2010). Advances in the physical and technological sciences will soon allow for the provision of high-fidelity weather and road condition data and forecasts, which could ameliorate these losses. Extensive social science research provides clues into the effective use of that information; for instance, Mileti and Sorenson (1990) highlight ‘hearing the warning’ as the first key step in an effective warning chain. Just over 91% of our survey respondents obtain weather forecasts, slightly lower than previous reports (e.g., Lazo et al. 2008). Of those that do obtain weather forecasts, the primary information source while not in a vehicle is local television stations, accessed on average 26 times per month (Figure 1). Internet is the second most popular choice, viewed roughly 20 times per month. Local radio (17 times per month) and cable television (15 times per month) are also popular information sources. The remaining options are much less frequently used. These results roughly parallel previous research (e.g., Hayden et al. 2007; Drobot 2007; Lazo et al. 2008). The major difference is that Internet sources have become more popular; for instance, they ranked below radio in Hayden et al. (2007). Whether the Internet ever surpasses local TV is debatable, but it clearly has risen in prominence over the past few years. Similarly, smart phone usage is up from previous studies, and it too likely will continue to climb in importance.

While in the vehicle, access to weather information is more limited and currently more passive, relying mostly on local radio stations (Figure 2). None of the other options rate at

higher than 5 times accessed per month. Nonetheless, smart phones clearly are being used by some people. Given the negative connotations of distracted driving, it may be that smart phone use is under-reported as well. The paucity of people using telephone (dial-in) sources suggests the 511 network is not being used very much for weather information.

4.2. Weather forecast and information preferences

Overall, survey respondents were generally satisfied with the weather information they currently receive (Figure 3). Roughly three in four respondents were either ‘satisfied’ or ‘very satisfied’, with temperature information rating the highest and precipitation information rating as the least satisfying of the three measures. When provided with a list of new information types that we anticipate as being available in the vehicle in the near future, respondents showed overwhelming support for most information types (Figure 4). Road closure information is marginally ahead of local weather conditions and local weather forecasts in terms of responses in the ‘very interested’ and ‘extremely’ interested categories. Weather conditions do rate higher interest than traffic conditions, accident information, and routing suggestions; this is slightly different from the JPO study, which had traffic information as the most desired variable. However, the current survey has more options in the traffic category (such as including road closures and accidents) and it is likely that this explains the disparity. Parking and points of interest are not highly desired by the respondents. Interestingly, when looking at the responses for ‘not at all interested’, local weather conditions and local weather forecasts have the lowest totals, with only 8% of the respondents showing no interest.

Stratifying the weather information into specific weather conditions continues to provide compelling information on the public desire for road and weather data and forecasts. Nearly two in three respondents are extremely or very interested in icy road warnings (Figure 5). Snow-covered road information is only slightly less desired. A variety of other precipitation measures, as well as low visibility and a general warning on whether or not weather will slow a trip are ‘very’ or ‘extremely’ desired by about 57% of the survey respondents. Only lightning ranks somewhat lowly, with only 40% of respondents ‘very’ or ‘extremely’ interested. Although the sample sizes are low, respondents that operated motorcycles daily or once a week tended to be more interested in these warnings (not shown).

The warning community stresses an effective response goes beyond hearing the warning, through to understanding it and ultimately taking action. Although the survey did not present respondents with particular warning messages, it did ask to what extent people felt that they would take protective action based on a warning. Owing to social desirability, which is the tendency of respondents to reply in a manner that will be viewed favorably by others, the responses may be overly positive for this question. However, numerous studies demonstrate the survey design used here should minimize social desirability, compared with telephone or in-person interviews (e.g., DeMaio 1984; Aquilino 1994). At any rate, the responses should provide a reasonable measure of which hazards people are more likely to respond to, relative to one another. In this respect, flooded roadways are the most likely hazard that if warned ahead of time, drivers would take protective action (Figure 6). Tornado, black ice, and hail warnings would engender a strong protective response as well. Falling rain and lightning are less likely to elicit any behavioral changes. As above, motorcycle riders were slightly more likely to indicate that they'd take protective action.

Despite an overwhelming interest in enhanced weather information, the public remains somewhat wary of sharing data (Figure 7). For some variables, such as air temperature, headlights, wipers, ABS, and time, more than half of all respondents are 'very' or 'extremely' comfortable with sharing the data. However, even for these variables, roughly 1 in 5 respondents were 'not at all' or only 'a little' comfortable. Moreover, approximately 1 in 3 respondents are 'not at all' or only 'a little' comfortable with sharing vehicle heading, speed, and direction, with more people falling into the 'not at all' or only 'a little' comfortable than 'very' or 'extremely' categories for location reporting.

Not surprisingly, the public's concern over data sharing is magnified when asked about what concerns them. Just over 60% of respondents are 'very' or 'extremely' concerned about being tracked (Figure 8), with just under 60% 'very' or 'extremely' concerned with respect to cyber-security and the potential cost. Interestingly, the least concerned-about item is privacy. However, even here, 2 in 4 respondents are 'very' or 'extremely' concerned, and only 1 in 4 are 'not at all' or 'a little' concerned. The lower privacy concerns may be related to a previous question where the respondents were told that the IntelliDriveSM program is being designed to ensure privacy. These results point out a clear need to market the program as a public benefit;

respondents overwhelmingly want more information, but remain wary of the data sharing that is needed for the development of the desired products.

A final question queried respondents on their willingness to pay for enhanced road and atmospheric weather data. Business models for the development of these advanced services are still under consideration, and these results might shed some light on the public viewpoint. Nearly half of all respondents were unwilling to commit to paying anything for these enhanced products (Figure 9). Qualitative answers associated with half of the responses suggest many people think that these services should be freely provided; a smaller portion feels that the existing information is already sufficient. The latter finding is consistent with the previous question on people's satisfaction with existing weather information, but it also further points out the need for a public campaign extolling the virtues of the proposed new systems. Only 18% of the respondents' were willing to pay at least \$10 per month. It is likely that weather hazard information may need to be bundled with other in-vehicle capabilities to make it more affordable or at least to increase its perceived worth.

5. Conclusions

This survey was intended to provide some basic insights into driver's preferences for in-vehicle weather and road condition hazard information and their attitude about sharing vehicle data. The results indicate that drivers are quite interested in knowing about road weather hazards while traveling, but that a solid business case (return on investment) will need to be made before most drivers will pay for these services. The survey data provides a rich dataset for study.

6. References

- Aquilino, W.S., 1994: Interview mode effects in surveys of drug and alcohol use: A field experiment. *Public Opinion Quarterly*. 58:210-240.
- DeMaio, T.J., 1984: Social desirability and survey measurement: A review. In C.F. Turner and E. Martin (Eds), *Surveying subjective phenomena: Volume 2*. New York: Russell Sage
- Drobot, S.D., 2007: Evaluation of winter storm warnings: A case study of the Colorado Front Range December 20-21, 2006, winter storm. NHC Quick Response Report #192.
- FHWA, 2010: http://ops.fhwa.dot.gov/weather/q1_roadimpact.htm. Accessed 27 November 2010.

- Hayden, M., S.D. Drobot, S. Radil, C. Benight, and E.C. Grunfest, 2007: Information Sources for Flash Flood and Tornado Warnings in Denver, CO and Austin, TX. *Environmental Hazards*, 7, 211-219, doi: 10.1016/j.envhaz.2007.07.001.
- Lazo, J.K., R.E. Morss, J.L. Demuth, 2009: 300 Billion Served. *Bulletin of the American Meteorological Society*. 90:785–798.
- Mileti, D.S., and J.H. Sorensen, 1990: Communication of Emergency Public Warnings: A Social Science Perspective and State-of-the-Art Assessment. Washington, DC: Federal Emergency Management Agency.
- Smith, A. 2010: Home broadband 2010. Pew Internet and American Life Project. 28 pp.
- Sorensen, J.H., 2000. Hazard warning systems: review of 20 years of progress. *Natural Hazards Review*. 1:119–125

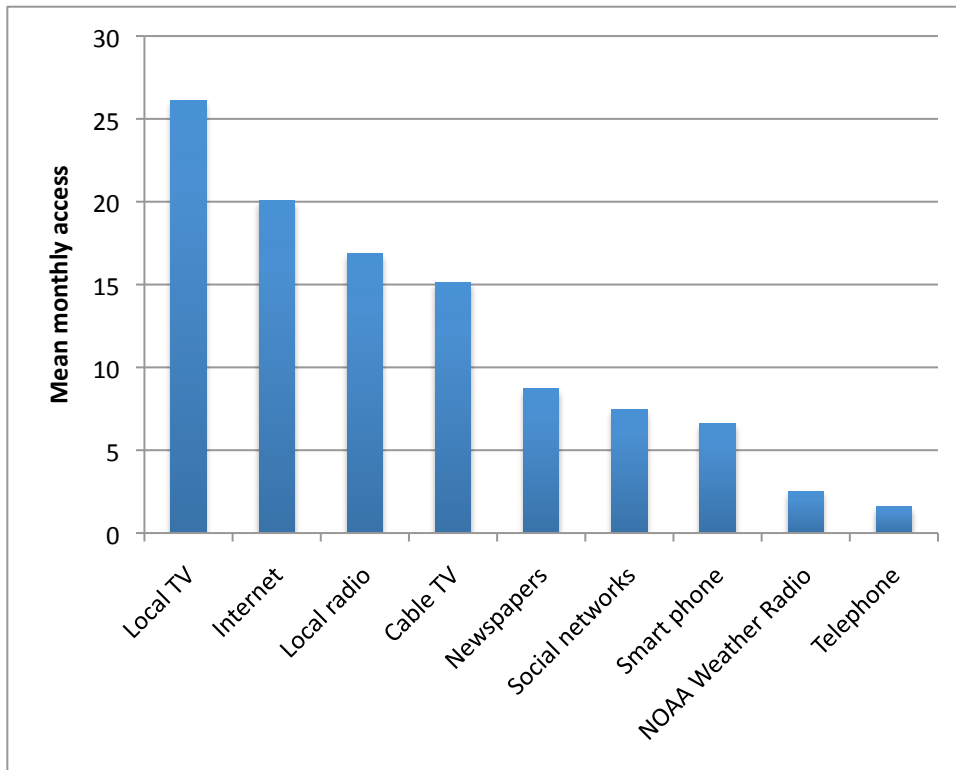


Figure 1. Number of times people gather weather information per month.

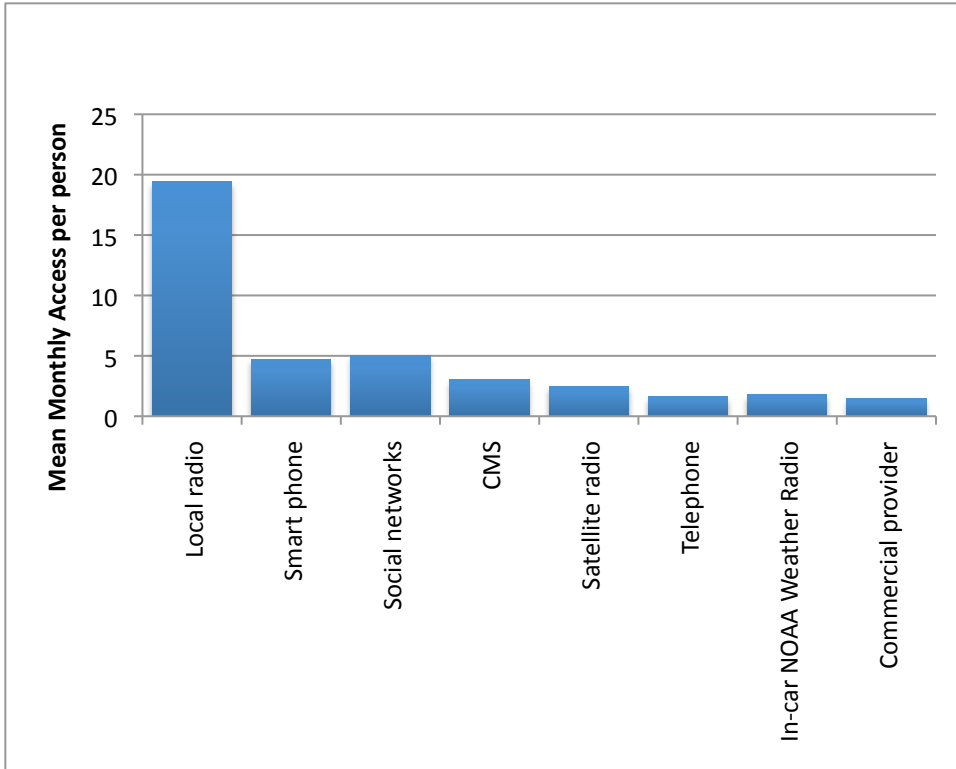


Figure 2. Number of times people gather weather information per month.

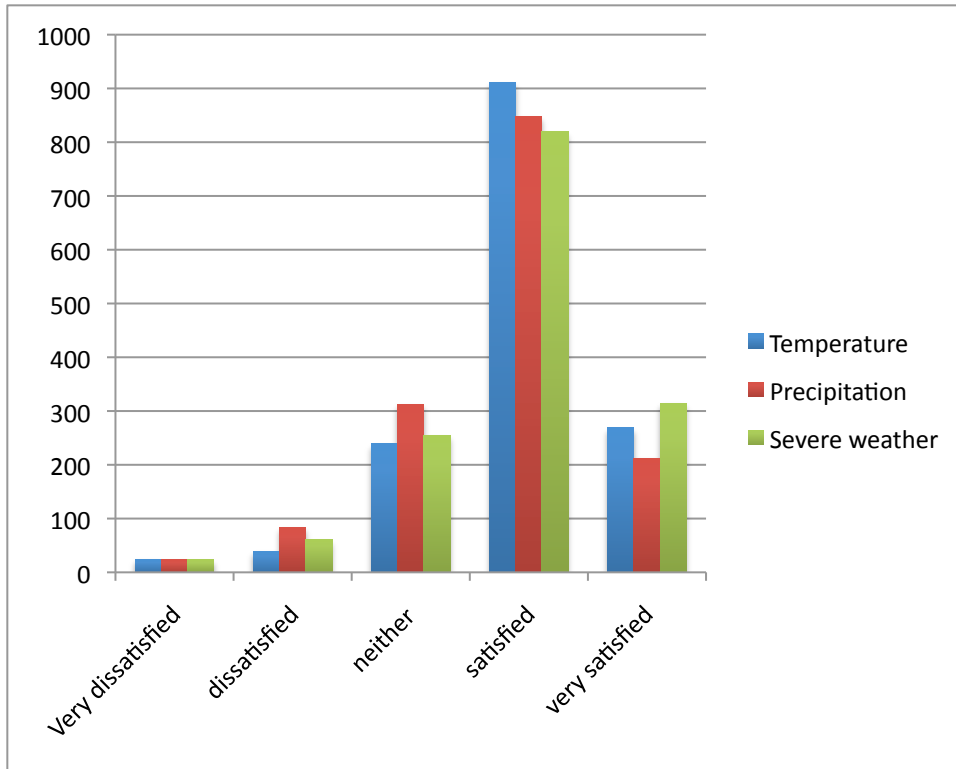


Figure 3. Satisfaction with weather warning information for temperature, precipitation, severe weather.

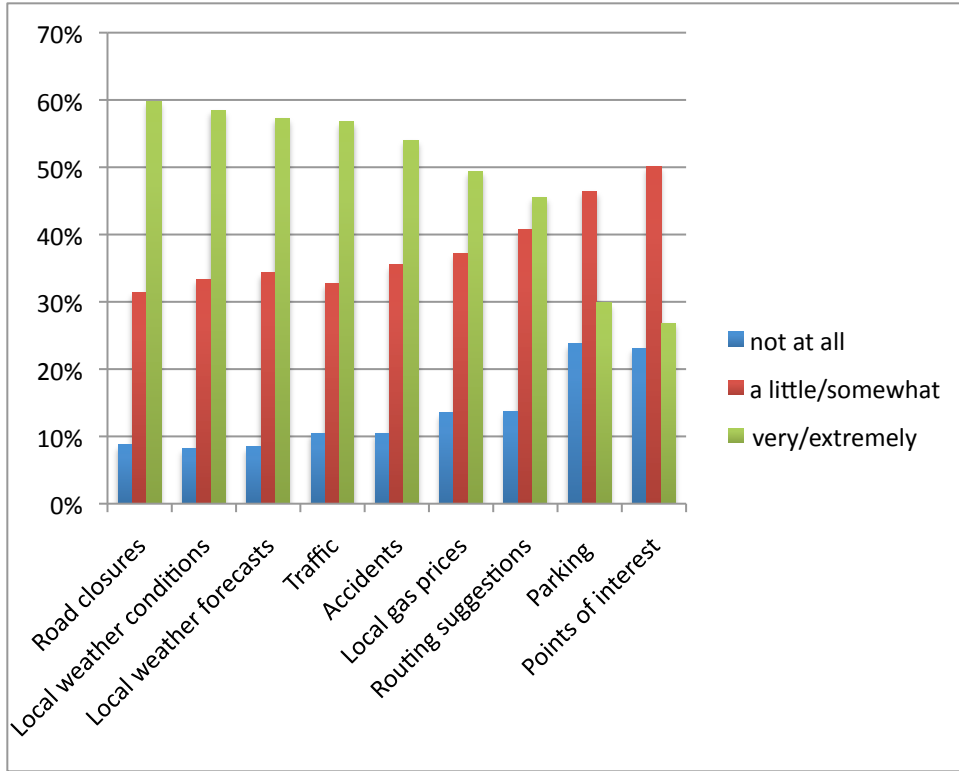


Figure 4. Interest level in various road and weather conditions for travelers.

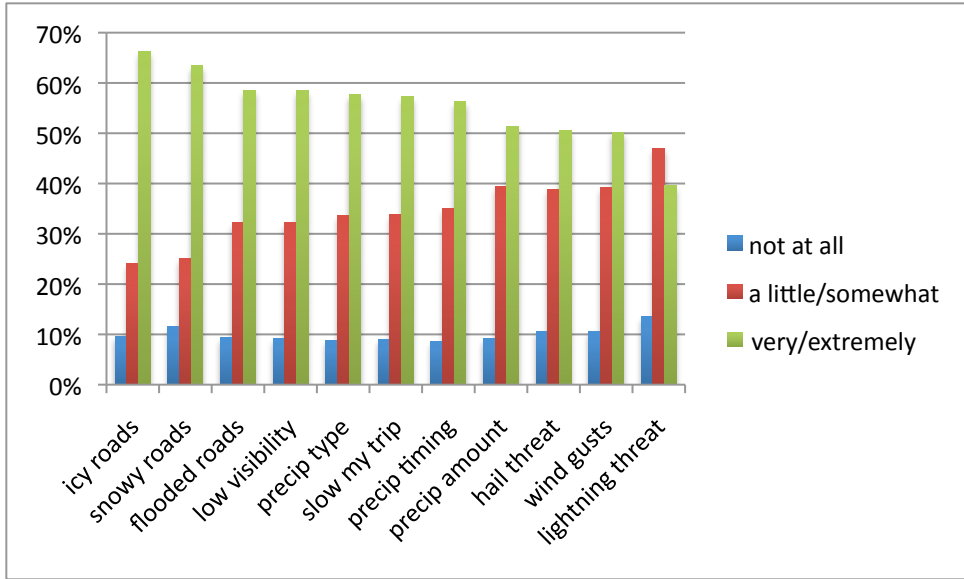


Figure 5. Interest level in various weather conditions for travelers.

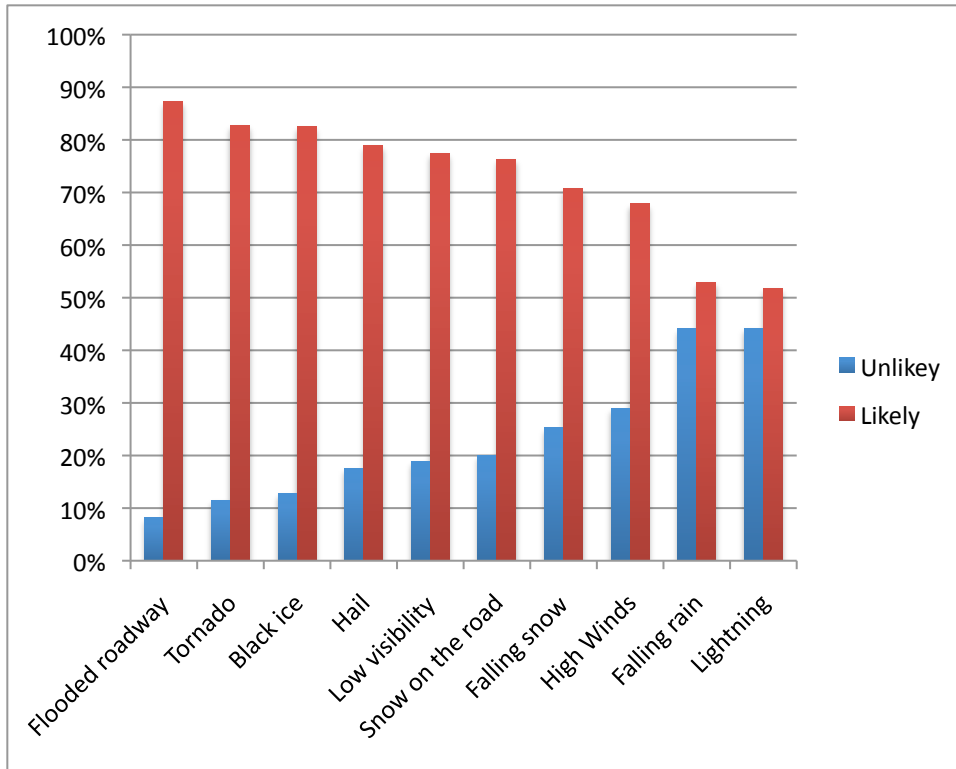


Figure 6. Likelihood that motorists would take protective action based on warnings for various road and weather hazards.

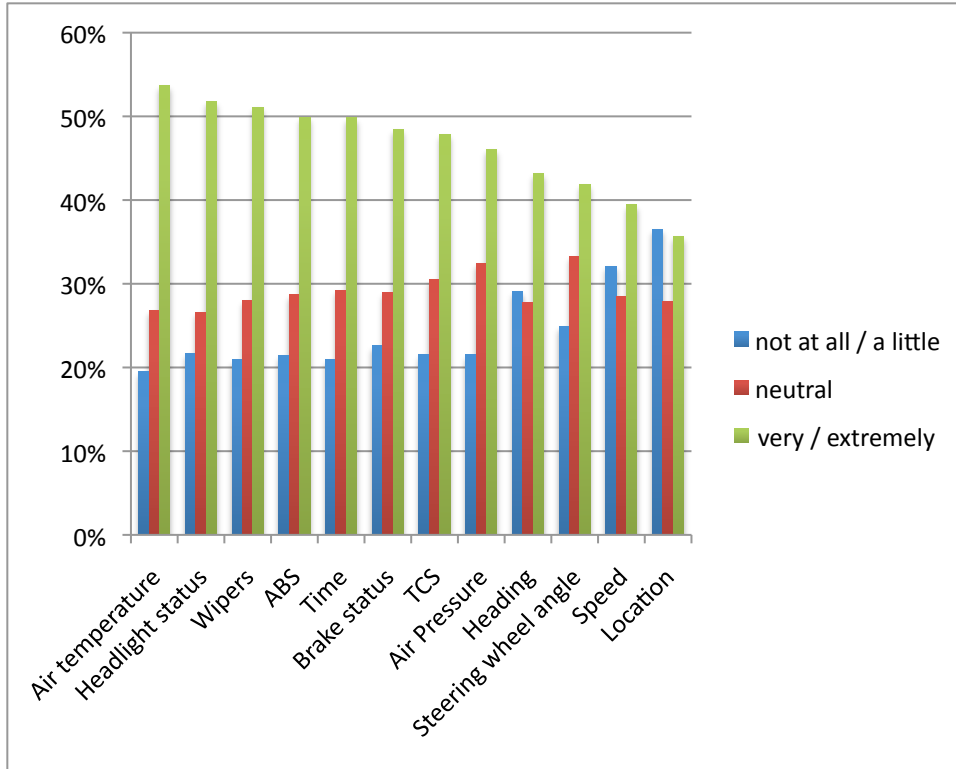


Figure 7. Comfort level for sharing vehicle data.

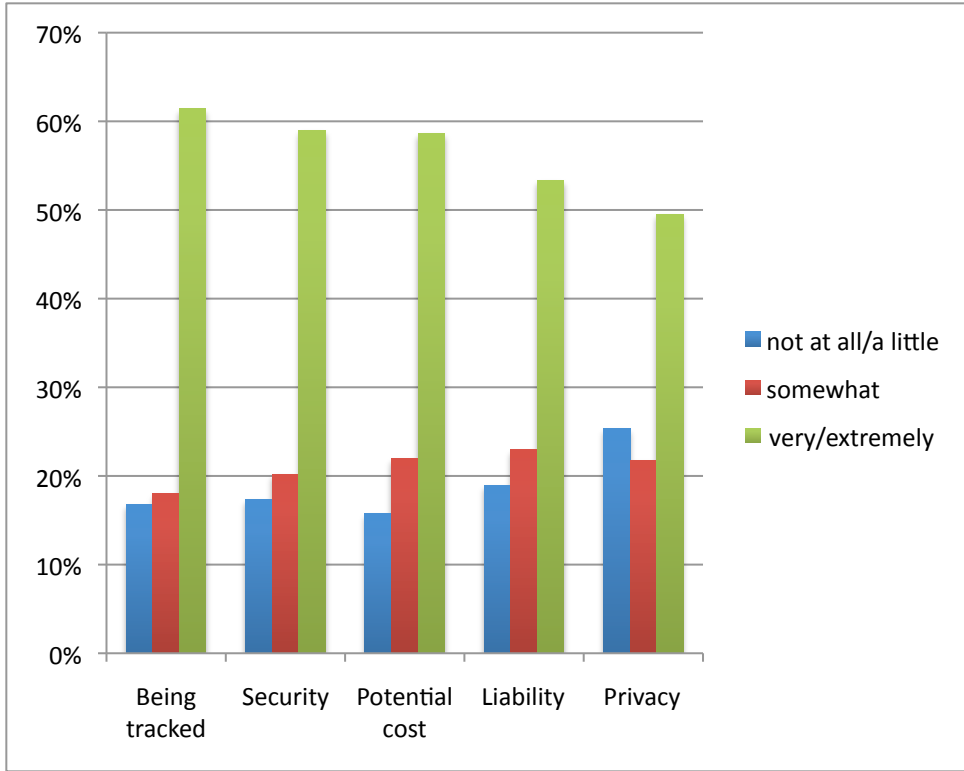


Figure 8. Respondents' level of concern regarding sharing data from vehicles.

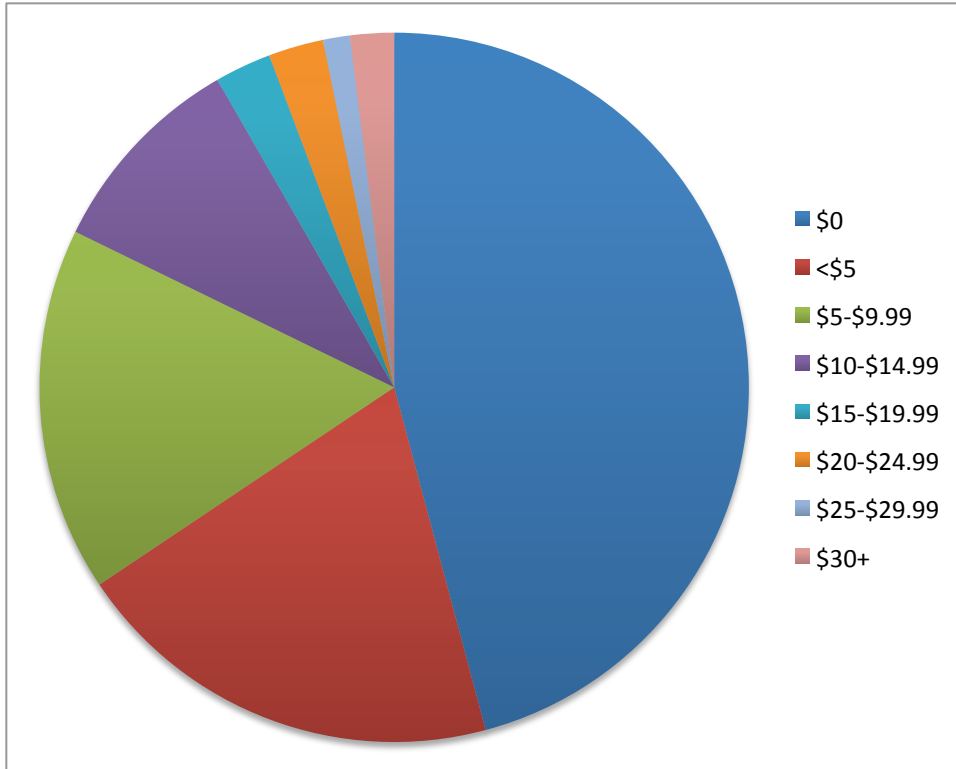


Figure 9. Respondents' willingness to pay for enhanced road and atmospheric weather information and forecasts.