Understanding People's Attitudes and Behaviors for Weather Forecast Information

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Introduction, data, and analysis methods

The meteorological community wants to provide better information in better ways to better serve the many users of weather forecast information. This requires empirical information about people's attitudes and behaviors regarding forecast information. This includes developing robust knowledge about from where people get weather forecast information, how they perceive it, and how they use it. To complement this knowledge, information is needed about what factors influence people's attitudes and behaviors.

Because empirical knowledge about these aspects is lacking, in 2006 the authors conducted a nationwide, controlled-access Internet survey of the U.S. public with a total of 1520 completed respondents. The survey included questions to assess people's sources, perceptions, uses, and values of weather forecast information (Lazo et al. 2009) and people's perceptions of, interpretations of, and preferences for forecast uncertainty information (Morss et al. 2008). To supplement the foundational knowledge reported in Lazo et al. and Morss et al., in this project we begin to explore what factors influence people's sources, perceptions, and uses of forecast information. Data for this project come from three sources:

(1) The aforementioned nationwide, controlled-access, Internet survey of the U.S. public – Of the 1520 completed responses, 3.6% of people indicated they never use forecast information, so the data are based on the remaining 1465 responses. In addition to data about people's sources, perceptions, and uses of forecast information, other data used here from the survey include questions about people's weather-related behavior, negative weather-related experience, and demographics.

(2) NWS verification data – Based on their reported zip code, survey respondents were matched to two NWS Weather Forecast Office (WFO) County Warning Area (CWA)-averaged measures of forecast accuracy: (a) root mean square error (RMSE) of maximum temperature forecasts, and (b) Brier Score of probability of precipitation (PoP) forecasts.

(3) NCDC data – Based on their reported zip code, survey respondents also were matched to two measures of forecast variability derived from NCDC Global Summary of the Day data: (a) mean absolute 24-hr variability in maximum temperature, and (b) mean absolute 24-hr variability in precipitation amount.

The survey provides a large amount of data, and we believed that some of the variables were measuring an underlying factor, so we first conducted a factor analysis to identify these latent variables. These factors were then used as dependent and independent variables in regression analyses to identify influential relationships on people's sources, perceptions, and uses of weather forecast information.

In this poster, we focus on people's sources of weather forecast information (based on from where and how often they obtain forecasts) using linear regression analysis. Additional regression analysis to explore relationships about (a) people's perceptions of forecast information (based on people's confidence in and satisfaction with forecasts and importance of NWS information); and (b) people's use of forecast information (based on people's use of forecasts for specific activities and importance of various parameters in a forecast) are not reported here due to space limitations.

Factor analyses of survey data

Factor analyses resulted in four broad sets of survey questions being reduced to fewer factors: (1) sources of weather forecast information, (2) confidence in weather forecasts of various lead times, (3) uses of weather forecast information for various activities, and (4) importance of different forecast parameters. Results are provided below in Tables 1-4, including the original variables and the resultant factors.

Table 1. Factor analysis of sources

Traditional	Non-Internet technology	Internet
• Local TV • Cable TV • Newspaper • Radio • Other people	• Telephone • NOAA Weather Radio • Electronic device	• NWS webpages • Other webpages

Table 2. Factor analysis of confidence

Shorter Lead-Time Forecasts	Longer Lead-Time Forecasts
• <1-day forecasts • 1-day forecasts • 2-day forecasts	• 3-day forecasts • 5-day forecasts • 7 to 14-day forecasts

Table 3. Factor analysis of forecast use

Personal Activities	Work-Related Activities	Non-Specific Activities that Affect Other Aspects
• Planning yard work or outdoor housework • Planning social activities • Planning weekend activities • Planning travel	• Planning how to get to work or school • Planning job activities	• Dressing yourself or children for the day • Simply knowing what the weather will be like

Table 4. Factor analysis of importance of forecasts parameters.

Precipitation Parameters	Non-Precipitation Parameters
• Chance of precipitation • Amount of precipitation • Type of precipitation • Chance of amount of precipitation • When precipitation will occur • Where precipitation will occur	• High temperature • Low temperature • Time of day high temperature occurs • Time of day low temperature occurs • Cloud cover • Wind speed • Wind direction • Humidity

Sources of forecast information

Survey respondents were asked "How often do you get weather forecasts from the sources listed below?" The response options—"rarely or never, once or more a month, once a week, two or more times a week, once a day, two or more times a day"—were re-coded to develop a quantitative count of access by source per month (Figure 1).

- The average respondent accessed weather information across all sources 115.4 times a month or 3.8 times a day.
- With a 2006 US adult population of 226 million this represents (adjusting for 3.6% non-users) over 300 Billion forecasts accessed a year by U.S. adults.

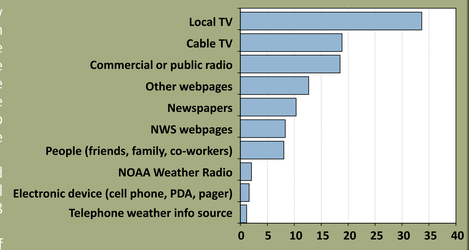

Figure 1. Average number of weather forecasts obtained monthly by source (n=1465).

Table 5. Linear regression results of variables influencing the factors of information sources (traditional, non-Internet technology, and Internet). Standardized coefficients are shown with significant variables highlighted in yellow. **p < 0.05 *p < 0.10

	Factor: Traditional Sources	Factor: Non-Internet Technology Sources	Factor: Internet Sources
Gender (female=1, male=2)	0.031	-0.023	0.067**
Full-time employment	0.019	-0.043	0.059**
Caucasian	-0.041	-0.021	0.028
Age	0.198**	-0.061*	-0.088**
Years of residence near current location	0.097**	0.042	-0.054*
Education	-0.055**	0.046*	0.013
Income	0.032	-0.004	0.031
Percentage of work time outdoors	0.009	0.081**	0.025
Mean weekly hours traveling to work	0.047*	0.018	-0.027
Percentage of leisure time outdoors	0.035	0.046	-0.006
Mean weekly hours working outside at home	0.039	0.017	-0.012
Variability in maximum temperature	0.034	-0.030	-0.072*
Variability in precipitation	-0.029	0.018	0.012
RMSE of maximum temperature forecasts	-0.058	0.060	0.118**
Brier score of PoP forecasts	0.076**	-0.001	0.043
Factor: Forecast use for personal activities (yard work, social events, travel, weekend)	0.164**	0.006	0.073**
Factor: Forecast use for work-related activities (getting to work, job activities)	0.112**	0.030	0.030
Factor: Forecasts use for non-specific activities that affect other aspects (dressing for day, knowing what weather will be like)	0.171**	0.001	0.062**
Factor: Importance of precipitation parameters in forecasts	0.086**	0.088**	0.072**
Factor: Importance of non-precipitation parameters in forecasts	0.042	-0.011	0.043
Satisfaction with weather forecast information	0.021	-0.003	0.061**
Factor: Confidence shorter lead-time forecasts (<1-day, 1-day, and 2-day forecasts)	0.021	-0.063**	0.041
Factor: Confidence in longer lead-time forecasts (3-day, 5-day, and 7 to 14-day forecasts)	0.039	0.103**	0.037
Importance of NWS information	0.072**	0.062**	0.035
Weather-related property damage	0.025	0.021	0.049*
Weather-related motor vehicle injury	0.025	0.032	0.004
Non-vehicular weather-related injury	-0.045*	0.025	-0.029
Weather-related medical condition	0.045*	0.004	0.049*

Factors influencing sources of information

The linear regressions on the three factors of weather forecast source information are shown in Table 5. This work is exploratory, but the regressions show some interesting results, some of which may reflect broader relationships and implications worth further exploration.

- Older people are more likely to rely on traditional sources (e.g., local and cable TV, paper, newspaper, and people) for weather forecast information, whereas younger people are more likely to utilize newer technologies (e.g., web, electronic devices).
  - This may suggest the need to consider how best to utilize technology to provide new forecast information and/or information via new media. It also implies the importance of weather forecast information being disseminated in multiple ways to reach the range of users.
- The longer people live near their current residence, the more likely they are to use traditional sources of forecast information.
  - This may reflect that the longer people live in an area, the more they develop trusted relationships with their local broadcast meteorologists, radio stations, and other people (friends, neighbors, co-workers) and consequently rely on these sources more.
- People who indicate they are more satisfied with the weather forecast information they receive are more likely to get their forecasts from web sources.
  - This may be due to the content and amount of information they can obtain from the web. For example, people can get specific forecast parameters, forecasts for specific areas, and more detailed information about a forecast (e.g., such as information about the uncertainty associated with a forecast).
- Finally, some of the regression results for traditional sources (e.g., local and cable TV, paper, newspaper, and people) may be reflecting how commonly these sources are used.
  - People who use forecasts for personal (yard work, social events, travel, weekend), work-related (getting to work, job activities), and non-specific activities that affect other aspects (dressing for the day, simply knowing what the weather will be like) may be getting forecasts more frequently for decision-making, and thus are more likely to use traditional sources.
  - When there is greater error in PoP forecasts, people may be getting forecasts more frequently because of the lack of accuracy in these types of forecasts, and thus are more likely to use traditional sources.
  - People with a weather-related medical condition may need to get forecasts more frequently because of their vulnerabilities, and thus are more likely to use traditional sources.

Future Work

Future work on this project will include several components:

- Additional interpretation of the linear regression results shown here;
- Linear regression analysis to explore what influences the factors derived about forecast use (Table 3) and importance of forecast parameters (Table 4);
- Ordinal regression to explore what influences people's confidence in forecasts, satisfaction with forecasts, and importance of NWS information; and
- Regression analysis to explore what influence's people's perceptions of, interpretations of and preferences for forecast uncertainty information.

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