The "Cry Wolf" Effect and Weather-Related Decision Making

Susan Joslyn & Jared LeClerc
Department of Psychology
University of Washington
Seattle, Washington, USA

Introduction

- Unacceptably high rates of non-compliance with weather warnings (e.g., only 46% compliance among the most vulnerable residents in Sandy's path, (Baker & Downs, 2013) may be due in part to a "cry wolf" effect (Breznitz, 1985): Ignoring warnings due to the past experience of false alarms (Dow & Cutter, 1998; Whitehead et al., 2000).
- **Combating the cry wolf effect: lower the false alarm rate or include uncertainty estimates?**
  1. Raising the warning threshold to reduce the occurrence of false alarms might encourage people to take appropriate precautionary action (Roulston & Smith, 2004). Not yet systematically tested in weather-related decision making.
  2. Including uncertainty estimates preserves the credibility of weather forecasts even when they do not verify (Joslyn & LeClerc, 2012).

Research Questions

What will increase compliance with weather warnings?

1. Decrease the **false alarm rate**?
2. Add an **uncertainty estimate** to the forecast?

Method

In a computer-based task, participants (N = 183) decided whether to treat a town's roads in the winter to prevent icy conditions. In each of 60 trials, participants saw a weather forecast for overnight low temperature and decided between two options:

A. Pay $1,000 to **apply salt** to guard against freezing temperatures
B. **Not apply salt**, but risk $5,000 penalty if freezing temperature observed

- Forecasts included (warning) advice from automated Decision Support Aid (DSA)
- Immediate feedback: Observed nighttime low temperature
- Budget: $35,000/month for two months ($70,000 total)

Example trial:

> The expected nighttime low temperature is 34°F.
> Decision Support Aid: "Applying salt is recommended under these circumstances."
>
> Would you like to salt the roads?
>
> [Salt] [Not Salt]

False Alarm Rate

Participants received decision advice at one of three levels.

Optimal strategy: Apply salt when freeze probability > 20%
$1,000 (cost) / $5,000 (potential penalty) = 0.2
} Economically optimal recommendation

High False Alarm	Economically Optimal	Low False Alarm
Apply salt when freeze probability > 10%	Apply salt when freeze probability > 20%	Apply salt when freeze probability > 30%

← false alarms
misses →

Prediction: Improvement in performance as false alarm rate decreases.

Uncertainty Estimate

Some participants were also shown freeze probability with each forecast:

> The expected low temperature is 34°F.
> **There is a 40% chance the temperature will be ≤ 32°F.**
> Decision Support Aid: "Applying salt is recommended under these circumstances."

Prediction: Improvement in performance with uncertainty estimate.

Control

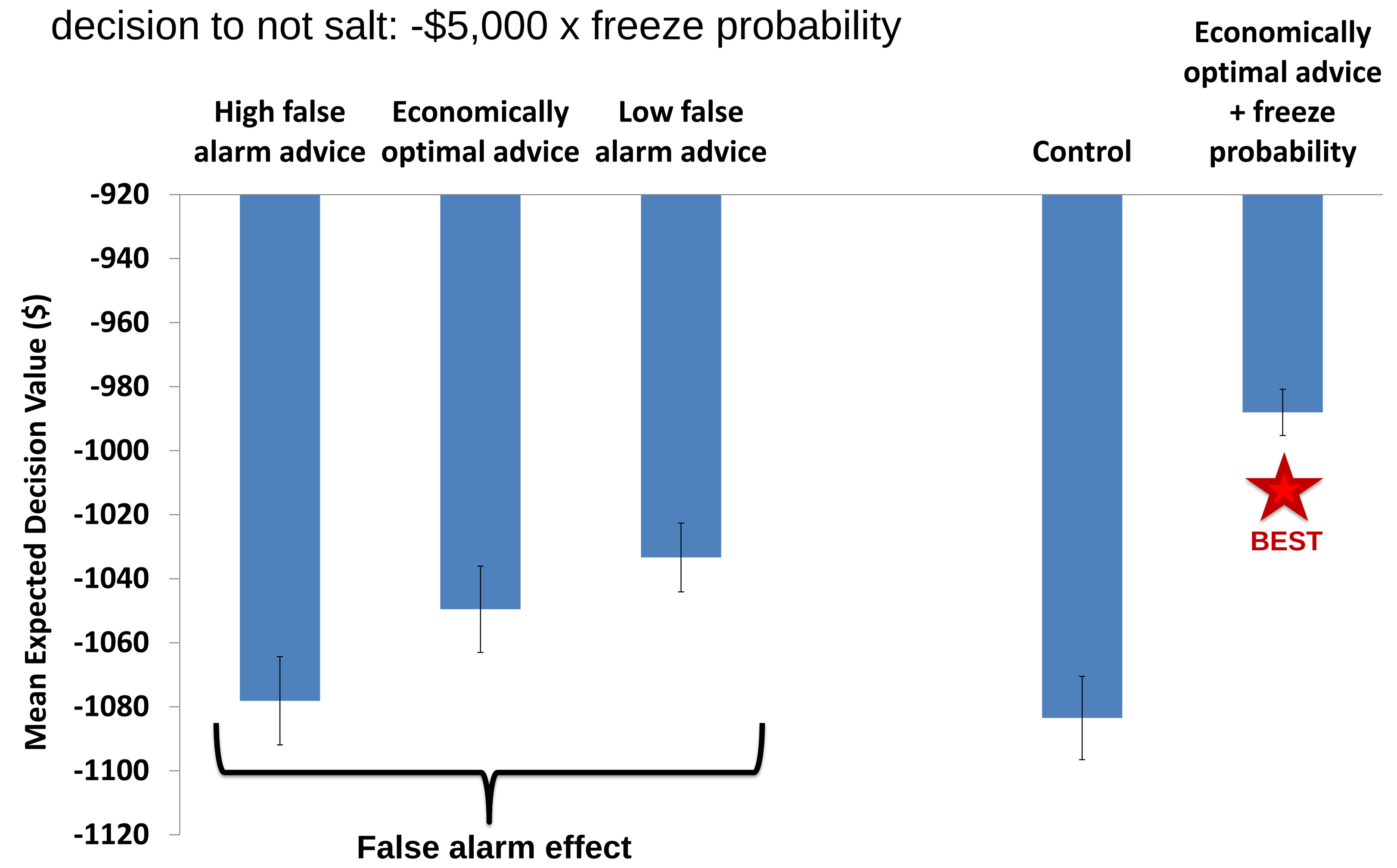
Some participants were shown only a single-value forecast:

> The expected low temperature is 34°F.

Results

Decision Quality

Mean expected value of participants' decisions:
decision to salt: -$1,000
decision to not salt: -$5,000 x freeze probability

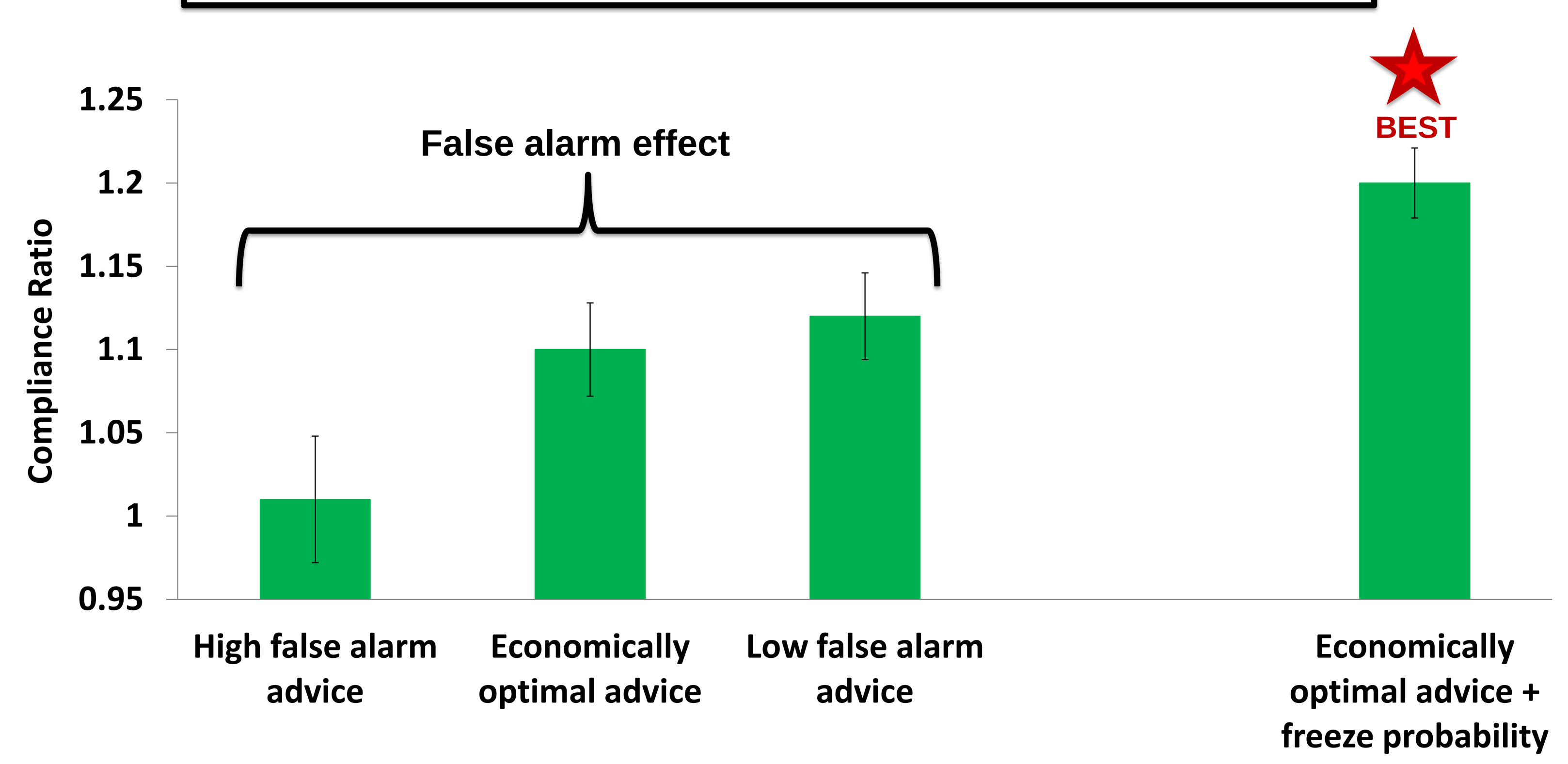


- False alarm effect, $F(2, 107) = 3.11, p = .05$: High false alarm advice did significantly worse than low false alarm advice, $p = .02$.
- No advantage to increasing warning threshold over optimal threshold: No statistical difference between economically optimal advice and low false alarm advice.
- Effect of including freeze probability, $F(3, 144) = 10.60, p < .001$: Outperformed economically optimal advice, $p < .001$, and low false alarm advice, $p < .01$.

Compliance

Ratio of proportion of trials in compliance with decision recommendation to baseline compliance rates of controls.

> **Ratio = 1.00**: On average, participants were not affected by the advice, i.e., they made the same decisions participants without the advice made.
> **Ratio > 1.00**: On average, participants were more compliant, i.e., they made decisions consistent with the advice more than participants without the advice did.



- False alarm effect, $F(2, 107) = 3.11, p = .05$: Higher compliance in low false alarm advice than high false alarm advice, $p = .02$, but no statistical difference between economically optimal advice and low false alarm advice.
- Effect of including freeze probability, $F(3, 144) = 10.60, p < .001$: Higher compliance than economically optimal advice, $p = .01$, and low false alarm advice, $p = 05$.

Conclusions

- There is a significant cry wolf effect in weather-related decisions.
- Reduction in false alarm rate did not significantly improve decision quality or increase compliance.
- A probabilistic uncertainty estimate improved both decision quality and compliance, perhaps making forecasts more credible despite false alarms.

References

Baker, J., & Downs, P. (2013). Hurricane Sandy exploratory study. Accessed online at www.stormrisk.org.

Breznitz, S. (1985). False alarms: Their effects on fear and adjustment. *Issues in Mental Health Nursing*, *7*(1-4), 335-348.

Dow, K., & Cutter, S. L. (1998). Crying wolf: Repeat responses to hurricane evacuation orders. *Coastal Management, 26*, 237-252.

Joslyn, S., & LeClerc, J. (2012). Uncertainty forecasts improve weather-related decisions and attenuate the effects of forecast error. *Journal of Experimental Psychology: Applied, 18,* 126-140.

Roulston, M. S., & Smith, L. A. (2004). The boy who cried wolf revisited: The impact of false alarm intolerance on cost-loss scenarios. *Weather and Forecasting, 19,* 391-397.

Whitehead, J. C., Edwards, B., van Willigen, M., Maiolo, J. R., Wilson, K., & Smith, K. T. (2000). Heading for higher ground: Factors affecting real and hypothetical hurricane evacuation behavior. *Environmental Hazards, 2*, 133-142.

This material is based upon work supported by the National Science Foundation under Grant No. 1023354.
For further information, please contact Susan Joslyn at susanj@uw.edu.