

# Understanding Psychological Factors that Influence Perceptions of Safe Shelter and Decisions to Shelter after a Tornado Warning

Marita A. O'Brien  
Franciscan University of Steubenville

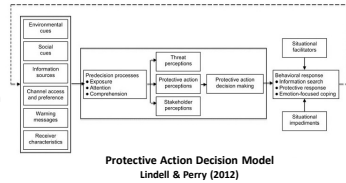
## Abstract

Numerous post-event studies of severe weather events across the U.S. have described examples in which individuals received sufficient warning but did not take appropriate protective action. In their Protective Action Decision Model, Lindell and Perry (2012) proposed that non-compliance was influenced by situational facilitators and impediments to the desired response. They describe examples of these facilitators and impediments that are primarily based on physical factors such as the availability of specific resources and facilities. More recent research suggests that psychological aspects of shelters and situational decision-making may also significantly influence appropriate response. This study was designed to identify those factors that lead to perceptions of shelter safety and the benefits of taking protective action among residents in a tornado-prone region of the U.S.

## Introduction

### Background:

- Appleton's (1975) prospect-refuge theory of human aesthetics suggests that safe places (i.e., shelters) offer individuals protection, brightness, and order. Identifying these characteristics in a potential shelter may make individuals more likely to take protective action there.
- Epstein's (1990) cognitive experiential self theory proposes that the basic needs of attachment, orientation and control, pleasure attraction/pain avoidance, and self-enhancement drive humans to approach or avoid specific stimuli (i.e., informs perception of threat).
- Kalscher & Williams' (2006) Interactive Social-Cognitive model highlights social (i.e., stakeholder) factors that influence warning compliance.
- The central component of Lindell & Perry's (2012) Protective Action Decision Model proposes that these perceptions that could influence decisions about responding to tornado warnings. Thus, understanding which factors actually influence perceptions during tornado warnings could inform design of tornado shelters, public education about tornado safety, and communications that accompany issuance of tornado watches and warnings.



### Key questions for study:

- What characteristics of a tornado shelter are most salient in advising a new community resident, especially those which suggest perceptions of safety for the shelter?
- Are participants' descriptions of tornado warnings and tornado experiences colored by emotion?
- Do participants explain or rationalize their protective action decisions using the factors proposed by the theories described above or by other psychological theories?

## Method

### Participants:

- 20 individuals from the University of Alabama in Huntsville and the surrounding community were interviewed. All participants had lived in the Southeastern U.S. for at least 4 years.
- 10 younger adults (19-25)
  - 4 female, racially diverse
  - University of Alabama in Huntsville undergraduate students
- 10 older adults (60-75)
  - 5 female, racially diverse
  - Community residents recruited through posters and experimenters' personal connections.

### Number of Tornado Warnings Experienced

	Younger Adults	Older Adults
20 and under	1	3
21 to 50	3	4
51 to 99	2	1
100 or more	4	2

### Number of Tornadoes Experienced

	Younger Adults	Older Adults
none	0	3
1-2	4	3
3-4	2	2
5-10	2	1
11-20	2	0
21 to 50	0	0
cannot reliably estimate	0	1

### Procedure:

- 2 experimenters interviewed each participant in a comfortable, enclosed room.
- Interviews ranged from 45-90 minutes.
- Structured interview format was primarily used, along with naturalistic scenarios about advice that would be given to another person with no tornado experience.
- Interviews were audio recorded, transcribed and uploaded to MAXQDA qualitative data analysis software.
- Two independent scorers coded each participant's responses following a predetermined coding scheme.



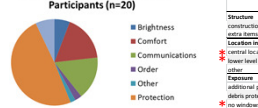
This study's focus was to confirm the coding scheme being used to identify psychological factors that influenced relevant perceptions and decision-making.

Shelter Codes	Emotion Codes	Action Codes
<b>Specific room (e.g., hallway, bathroom)</b> <b>Protection</b> <ul style="list-style-type: none"> <li>• Exposure                             <ul style="list-style-type: none"> <li>◦ Away from windows</li> <li>◦ Debris protection</li> <li>◦ Blast protection</li> <li>◦ Additional personal protection (e.g., blankets, cushions)</li> </ul> </li> <li>• Structure                             <ul style="list-style-type: none"> <li>◦ Entry items in room to get under</li> <li>◦ Construction of room</li> </ul> </li> <li>• Location in building                             <ul style="list-style-type: none"> <li>◦ Centrally located</li> <li>◦ Lowest level/underground</li> <li>◦ Secure from other people</li> </ul> </li> </ul> <b>Impediments</b> <ul style="list-style-type: none"> <li>• Spaciousness</li> <li>• Lightness</li> <li>• Visibility outside</li> </ul> <b>Order</b> <ul style="list-style-type: none"> <li>• Tidy &amp; uncluttered</li> <li>• Clean and hygienic</li> </ul> <b>Communications</b> <ul style="list-style-type: none"> <li>• Authoritative source</li> <li>• Personal connections (e.g., cell phone)</li> <li>• Local references</li> <li>• Social information</li> </ul> <b>Comfort</b> <ul style="list-style-type: none"> <li>• Comfortable resting area</li> <li>• Food &amp; water</li> <li>• Entertainment</li> <li>• Health</li> <li>• Privacy</li> </ul>	<b>Warning Phase</b> <ul style="list-style-type: none"> <li>• Neutral</li> <li>• Worry</li> <li>• Aftermath</li> </ul> <b>Warning Phase</b> <ul style="list-style-type: none"> <li>• Fearful</li> <li>• Worry</li> <li>• Aftermath</li> </ul> <b>Self (includes self)</b> <ul style="list-style-type: none"> <li>• Other</li> </ul> <b>Structure</b> <ul style="list-style-type: none"> <li>• Positive</li> <li>• Negative</li> <li>• Neutral</li> <li>• N/A</li> </ul>	<b>Warning Phase</b> <ul style="list-style-type: none"> <li>• Neutral</li> <li>• Worry</li> <li>• Aftermath</li> </ul> <b>Action Phase</b> <ul style="list-style-type: none"> <li>• Normal</li> <li>• Worry</li> <li>• Aftermath</li> </ul> <b>Action</b> <ul style="list-style-type: none"> <li>• Protective action</li> <li>• Non-protective action</li> <li>• Unsafe action</li> <li>• Injured action</li> <li>• Property protection</li> <li>• Nature protection</li> <li>• Physical response</li> <li>• Other action</li> </ul> <b>Rationale</b> <ul style="list-style-type: none"> <li>• Beliefs about protective actions &amp; shelters</li> <li>• Need for control &amp; orientation</li> <li>• Desire for pleasure</li> <li>• Desire to avoid pain</li> <li>• Need for self-empowerment &amp; identity</li> <li>• Prior experience</li> <li>• Social information</li> <li>• Inexpensive items</li> <li>• Metacognitive beliefs</li> <li>• Beliefs about tornadoes, weather &amp; interaction with local geography</li> </ul>

## Results

### Shelter Characteristics

#### Characteristics of Shelter for All Participants (n=20)



#### Protection Codes Detailed

	Younger Adults	Older Adults
Structure	4	4
construction of room	4	3
entry items in room to get under	0	1
location in building	0	0
central location	0	0
lowest level	0	0
other	0	1
additional personal protection	0	7
debris protection	0	0
blast protection	0	0
explosion protection	0	0
critical shelter recommendation by NWS	0	0

#### Comfort Codes Detailed

	Younger Adults	Older Adults
well-lit/vent	0	0
roof and water	5	5
health	4	3
privacy	1	1
living area	1	2
other	0	0

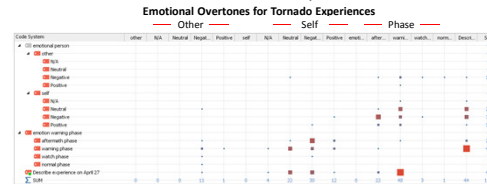
#### Communication Codes Detailed

	Younger Adults	Older Adults
authoritative source	0	7
local references	1	0
personal connections	0	0
social information	0	0
other	0	0

By far, the most important shelter characteristic is Protection with the next most salient characteristics of Comfort and Communications – characteristics that are consistent with the dynamic but short-term nature of the tornado hazard. Note also that most participants cited the critical characteristics specified by the National Weather Service for taking shelter in response to a tornado warning.

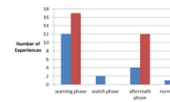
### Emotional Elements of Tornado and Tornado Warning Experiences

All participant descriptions of their tornado experiences were examined for emotional overtones (positive or negative) by the participant or others in the scenario. Every participant's description of their experience on April 27, 2011 was coded for an emotional overtone, neutral description, or not applicable because of the person's location out of Northern/Central Alabama on that day.

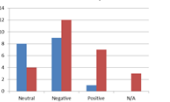


The most frequent experienced emotions were negative, primarily fear and frustration. A medium-sized minority described their experiences in matter-of-fact tones, but the fact that these were only coded for April 27 may have proportionately reduced their significance compared to affective descriptions. Positive emotions during the warning typically indicated that participants were calm as they waited out the warning, whereas positive emotions after the warning were associated with gratitude and awe.

#### Tornado Warning Phase for Emotional Code



#### Emotional Code for Experience

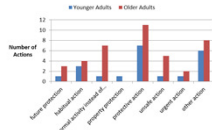


Older adults were more likely to describe emotions both during the tornado warning and from viewing a tornado's aftermath. Older adults are also more likely to have positive experiences whereas younger adults were more likely to describe their experience without significant affect.

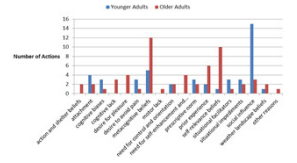
## Protective Action Decisions and Rationale

During the interviews, younger adults described 21 actions and older adults described 40 actions. Fewer than 20% of the described actions were performed by another person.

### Types of Actions Described



### Rationale for Described Actions

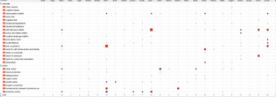


The left graph shows that the most frequent action was a protective action, followed by other actions such as calling others to inform them about the warning. The pattern of actions was similar between age groups. Age differences were identified for decision rationale, however, with social influence affecting young adults' decisions more and self-relevance (i.e., judgment that they were vulnerable (or not) for the particular tornado being warned) higher for older adults. Note that both groups also use metacognition (knowledge and processes to inform their beliefs and decisions).

### Rationale Correlated with Actions for Younger Adults

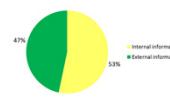


### Rationale Correlated with Actions for Older Adults

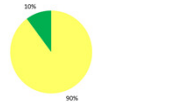


The left graph shows even more clearly the dominant influence of other people on younger adults' protective action decisions. In our interviews, even the unsafe action (watching the tornado from a rooftop) was influenced by friends. In contrast, older adults had more varied rationale for their decisions. They relied more on their own knowledge (e.g., prior experience, beliefs about safe actions, and judgments about vulnerability at the time). Older adults also more intentionally considered their role in the group of individuals they were with at the time (i.e., need for self-enhancement and identity) to inform their decisions. The graphs below show this general age difference in use of internal vs. external rationale.

### Younger Adults' Rationale



### Older Adults' Rationale



## Discussion

### Key Findings:

- Salient characteristics of tornado shelters primarily describe protection factors (49%), but comfort (17%) and communications (16%) are also important. Good design should likely facilitate all three elements.
- Predominant emotions described for tornado warning experiences are negative, but many people also describe the experience in neutral tones. Some describe the experience positively.
- Older adults' higher frequency of emotional descriptions for tornado aftermath, especially positive emotions, suggests that they may be more likely to evaluate the results of their decisions.
- Internal information such as knowledge, desires, and preferences are used more than external information such as other people to decide about protective actions.
  - Younger adults use more social information than older adults.
  - Older adults use little external information but rely on their prior experience and judgments.
- Metacognitive processes are used by participants in both age groups.

### Future Research:

- Adjust coding scheme to add appropriate level of detail to metacognitive coding
  - Knowledge of self & others, tasks, strategies and effectiveness
  - Planning, monitoring, and evaluation processes
- Supplement coding scheme with Cognitive Task Analysis codes to enhance visibility about evaluation of sources of information for all decisions (Shreeves & O'Brien, 2013)
  - Internal information (e.g., geographic locations, NWS recommended practices for shelter)
  - External information (e.g., weather, examples of effective protective actions)
- Finish coding participants with revised coding scheme.
- Statistically compare older and younger adults using larger sample size.

**Author's Note:** This research was supported in part by a grant from the Office of Sponsored Programs at the University of Alabama in Huntsville. I thank Kimberly Beam, Lara Corum, Kim Dyer, and Robert Whittaker for their assistance interviewing participants and scoring participant responses. I am also grateful to Victoria Blakely, Melissa Gray, Deanna Nicholas, Paula Tucker, and Andy Waldon for their assistance with data entry and coding.